A STUDY ON FUNCTIONAL OUTCOME FOLLOWING SURGICAL FIXATION FOR SUBAXIAL CERVICAL SPINE INJURIES

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CHENNAI, TAMILNADU

CERTIFICATE

*This is to certify that this dissertation entitled "***A STUDY ON FUNCTIONAL OUTCOME FOLLOWING SURGICAL FIXATION FOR SUBAXIAL CERVICAL SPINE INJURIES"***is the bonafide work done by Dr.GANESHKUMAR .M, Postgraduate in the Department of Orthopaedic Surgery, Madurai Medical College, Madurai*

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CERTIFICATE

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DECLARATION

I, **Dr. GANESHKUMAR.M**, *solemnly declare that the dissertation titled "***A STUDY ON FUNCTIONAL OUTCOME FOLLOWING SURGICAL FIXATION FOR SUBAXIAL CERVICAL SPINE INJURIES",** *has been prepared by me. This is submitted to* **"The Tamil Nadu Dr. M.G.R. Medical University, Chennai,** *in partial fulfillment of the regulations for the award of M S degree branch II Orthopaedics.*

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INTRODUCTION

Cervical spine injuries are one of the common causes of serious morbidity mortality following trauma. 6% of trauma patients have spine injuries of which >50% is contributed by cervical spine injury [1]

Jefferson found that injuries to the cervical spine involve two particular areas: C1-2 and C5-7. Meyer identified C2 and C5 as the two most common level of cervical spine injury. Injuries of the cervical spine produce neurological deficit in approximately 40% of patients. Approximately 10% of traumatic cord injuries have no obvious radiographic evidence

Early recognition, immobilisation, preservation of spinal cord function, and stabilisation are the initial management of patients with cervical spine injuries.

Cervical instability due to trauma is usually from the level of C3 to C7(i.e subaxial).Neurological deficits are common i.e root compression and cord compression with subluxation and dislocation.(1)

Unstable cervical spine injuries with or without neurological deficit require open reduction stabilisation is done by using various implants and bone grafting. Implants provide immediate stability, whereas bone grafts provide long term stability by achieving intertvertebral fusion.

There is debate in the literature regarding the approach to stabilisation of these fractures, particularly with regard to injuries with disruption of both the anterior and posterior columns. The different approaches that can be used are anterior, posterior, or combined approaches. Halo vests have also been advocated for treatment of these fractures.

Four characteristic mechanisms of primary injury: (i) impact plus Persistent compression; (ii) impact alone with transient compression; (iii) distraction and (iv) laceration and transaction . The first and most common mechanism involves impact plus persistent compression. This is evident in burst fractures with retropulsed bone fragments compressing the cord, fracture-dislocations, and acute disc ruptures. The second mechanism involves impact alone with only transient compressions as observed with hyperextension injuries in individuals with underlying degenerative cervical spine disease.(2)

Distraction, forcible stretching of the spinal column in the axial plane, provides a third mechanism and becomes apparent when distractional forces resulting from flexion, extension, rotation, or dislocation produce shearing or stretching of the spinal cord and/or its blood supply. This type of injury may underlie SCI without radiological abnormality, especially in children where cartilaginous vertebral bodies, underdeveloped musculature, and ligament laxity are predisposing factors . This type of injury may also be a causative factor in SCI without radiologic evidence of trauma, which is a syndrome most common in adults with underlying degenerative spine disease . Laceration and transection comprise the final primary mechanism of injury. Laceration of the spinal cord may result from missile injury, sharp bone fragment dislocation, or severe distraction.

Further transport of the patients and persistent movements of neck will results in secondary impact and compression .cervical spine instability also contributes the additional factor for secondary impact and compression.

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Hence to relieve from the primary impact , persistent compression and alignment of stable anatomy of cervical spine, early surgical intervention is necessary to relieve persistent compression and stabilization of subaxial cervical spine injuries .we have done the procedure of decompression and fusion with cervical H plate for the subaxial cervical spine injuries.(2)

AIM OF THE STUDY

To study the Functional outcome following surgical fixation for subaxial cervical spine injuries involving patients who are all admitted with subaxial cervical spine injuries and amenable to intervention in our Department of Orthopaedics and Traumatology, Govt Rajaji hospital, Madurai from September 2012 to September 2014.

REVIEW OF LITERATURE

HISTORICAL REVIEW

1550BC Egyptian considered acute neck injury as " ailment not to be treated"[3.]

460-377 BC- Hippocrates introduced the methods of traction in prone position for treating spine injuries[3].

1672-Hildanus introduce the technique for reducing dislocation of cervical spine[3.]

1700-1780-Paul of Agenda suggested excision of fractured spinous process for treating spinal disorders.[3] .

1809- Malgaigne said all spinal fractures resulted in paralysis[3.]

1856-1904 Chipault- a French surgeon published the first text book on spinal surgery presenting the most complete survey of past & current spinal surgery[3.]

1925-John Davis-first usable lateral radiograph of spine.[3]

1928 Stuckey approached the cervical spine anteriorly for the chordoma.[3]

1929- Taylor introduced head-halter traction.[3]

1958- Cloward -introduced the anterior approach for degenerated disc[3]

1960- Baily& Badgley described the method of anterior cervical fusion of the anterior cervical fusion of cervical of spine using iliac crest graft.[3]

1962-Robinson-Anterior arthrodesis using horse shoe shaped iliac crest graft.[3]

1970-Orosco & Lovet-first to secure a bone chip with a plate,for fractured cervical spine [3]

1991-Zdeblick-used freeze dried allograft bone for cervical fusion.[3]

1996-Shapiro used banked fibula and the locked anterior cervical plate for anterior cervical fusion.[3]

1999-Melca-use of bovine (xenograft) with anterior cervical plate for anterior cervical fusion

1999-Majid-used Titanium mesh cages with auto grafts and anterior plates for anterior arthrodesis.

Later , Bartels and Donk performed combined approach for neglected subaxial cervical spine injures.

ANATOMY OF SUBAXIAL CERVICAL SPINE

DEVELOPMENTAL ANATOMY OF CERVICAL SPINE

ANTENATAL DEVELOPMENT

During 3rd week of intrauterine life, development of mesoderm on either side of neural tube and notochord becomes aggregated to form **Somite**s. Somites differentiate into ventromedial part (the sclerotome) and dorsolateral part (the dermatomyotome) During 4th week, sclerotome forms the vertebra, ribs and the spinal ligaments ,while the dermatomyotome forms the musculature and dermis of scalp, neck & trunk.

The cranial half of first cervical sclerotome fuses with the caudal portion of fourth occipital somite to form basilar portion of occipital bone. Caudal half of first cervical sclerotome fuses with cranial half of second cervical sclerotome to form first cervical vertebra .The same type of fusion repeated down the length of cervical spine.[4]

POST NATAL DEVELOPMENT

Ossification centers in lateral masses that expand into posterior arches join by about 3 years of age. A secondary ossification centre develops in the anterior arch of the cervical vertebra by one year of age. It fuses with the lateral masses by 6 to 9 years.

CLINICAL ANATOMY

Vertebral column is made of five parts viz..cervical, thoracic, lumbar ,sacral & coccygeal parts. Cervical spine consists of 7 vertebral, first two of which Atlas &Axis are atypical and C3 to C7 are typical.

Typical cervical vertebra

They are structured to provide limited flexion,extension,tilt and rotation and to provide stability to the head. Vertebral bodies have a superior surface , which is concave laterally and convex antero posteriorly. This configuration allows flexion, extension, lateral tilt by gliding movements of facet joints . Inferior surface of vertebral body is convex. Lateral aspect of body has superior projection called uncinate process.

The lamina and spinous process of C2 vertebra are the largest, whereas C3,C4,&C5 vertebrae have thin lamina and help assume the normal lordotic posture. The spinous processes of 3rd , 4th and 5th cervical vertebra are bifid. The lamina of 6th and 7th cervical vertebra become progressively thickened and larger to approach the size of the thoracic vertebra. The facet joints are placed in a coronal plane angled 45 inclination, lateral tilt is accompanied by rotation and vice versa. The gliding motion of facets allows flexion, extension and lateral tilt.[4]

OSSEOUS STRUCTURES

The osseous constituents of each vertebra and its structure of articulations with adjacent vertebrae are constant from third to seventh cervical vertebra . Each cervical vertebra consists of an vertebral body, from which the pedicles extend posteriorly to meet the lateral masses , lamina and spinous process thus forming an osseous canal that envelopes the spinal cord. An important structure which arising from the posterolateral corner of the vertebral body's superior surface is the uncinate process, which forms the uncovertebral joint of Luschka with a complementary convexity on the inferior surface of the suprajacent vertebral body. The uncinate process is an important landmark for defining the lateral boundary of vertebral body when performing an anterior discectomy or corpectomy. (4)

Extending laterally off the pedicle and anteriorly from lateral mass are tubercles that form the transverse process, which cradles the nerve root exiting in its superior surface. Within the transverse process is a round defect called the foramen transversarium, through which the vertebral artery ascends, typically by skipping the foramen at the level of C7 and entering at C6.

The lateral mass consists of the superior and inferior articular facets, which, when viewed from the side, give the lateral mass a rhomboid-shaped appearance . When viewed in cross section, the inferior articular facet lies posterior to the superior articular facet of the subjacent vertebrae. This “shingling” configuration can cause confusion when interpreting axial computed tomography (CT) scans .

The laminae extend posteromedially from the lateral masses and converge on the midline to form the spinous process. At C3, C4, C5, and often at C6, the spinous process are bifid. The C7 spinous process is usually the most prominent dorsal structure in the lower cervical spine and represents a useful landmark for making the skin incision for posterior approaches.[4]

NONOSSEOUS STRUCTURES

The most important non osseous structure of the spinal column is the intervertebral disc material . Like that of lumbar spine, the intervertebral disc material consists of a central, gelatinous nucleus pulposus surrounded by its tough, fibrous annulus fibrosus. The disc is bordered superiorly and inferiorly by a cartilaginous end plate, and laterally by the unco vertebral joints. The disc represents an important stabilizing structure for the motion segment.(4)

A number of important ligamentous structures present within the subaxial cervical spine and also contribute to its stability . The anterior and posterior longitudinal ligaments run cephaled to caudal along the anterior and posterior aspects of the vertebral body. The ligamentum flavum extends between the laminae. The interspinous and supraspinous ligaments run between spinous processes and their tips, respectively. Although distinguished in most anatomic textbooks, the interspinous and supraspinous ligaments are essentially continuous and form a “nuchal ligament” complex with the structure of ligamentum nuchae.

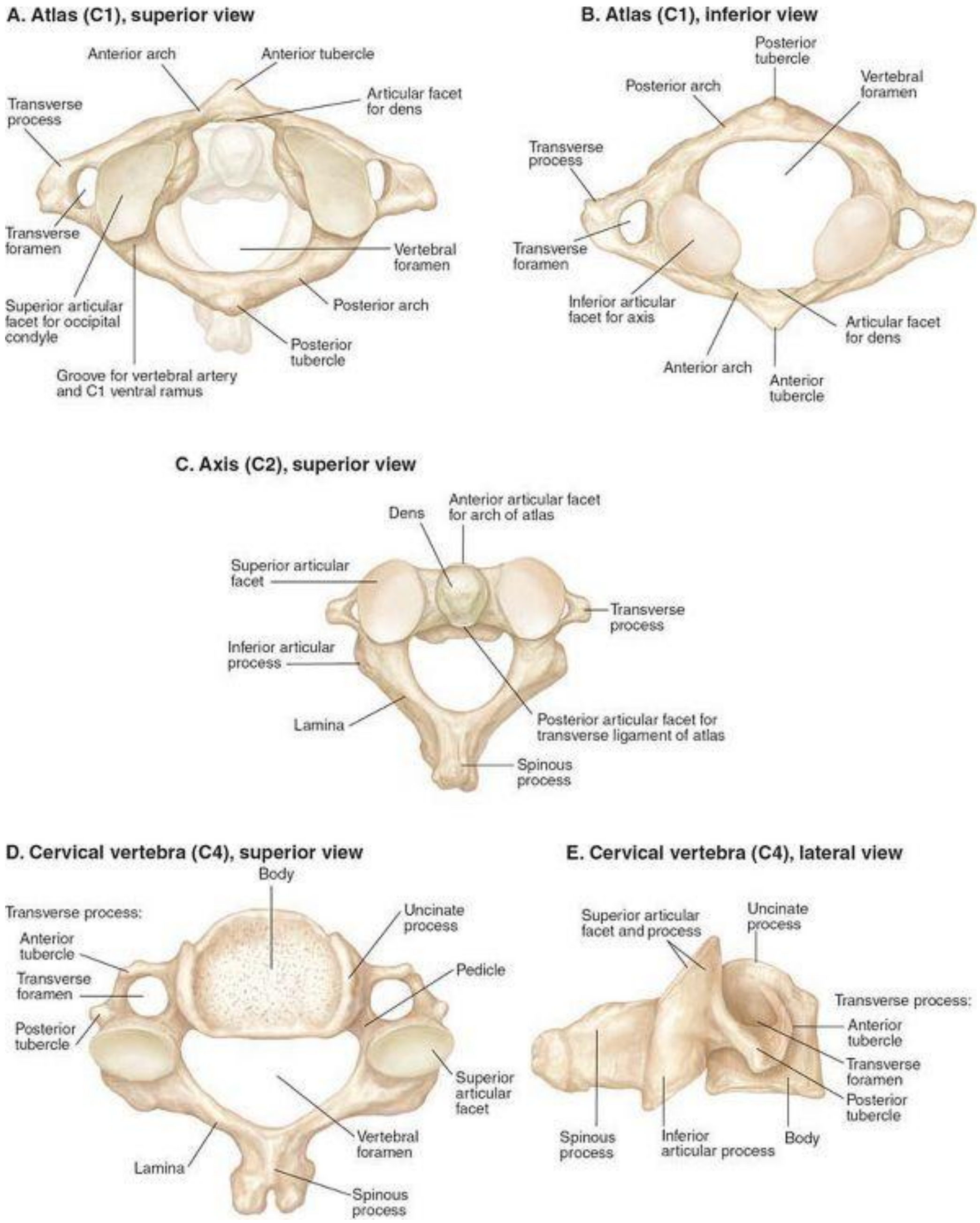

Fig.1 Anatomy of cervical vertebra

THE SPINAL NERVE

Spinal nerve exiting from spinal canal passes through the inter pedicular foramen. Laterally in the intertransverse foramen, it divides into two ,a large ventral ramus and a smaller dorsal ramus. The ventral ramus courses on the transverse process in the anterolateral direction to form the cervical and brachial plexus.

On oblique sagittal radiological views ,the cervical nerve root is located in the lower part of the interpedicular foramen and occupies the major part of intertransverse foramen. On the posterior aspect of lateral mass, the mean distance is about 5.6mm from the posterior centre of the lateral mass to the projection of the spinal nerves superiorly and inferiorly. 4

THE VERTEBRAL ARTERY

Vertebral artery, a major arterial supply , originates from the subclavian artery,enters the transverse foramen of the 6th cervical vertebra,and its courses upwards through the transverse foramen . On the transverse plane ,the vertebral artery lies infront of the lateral mass,but is separated by the spinal nerve.(4)

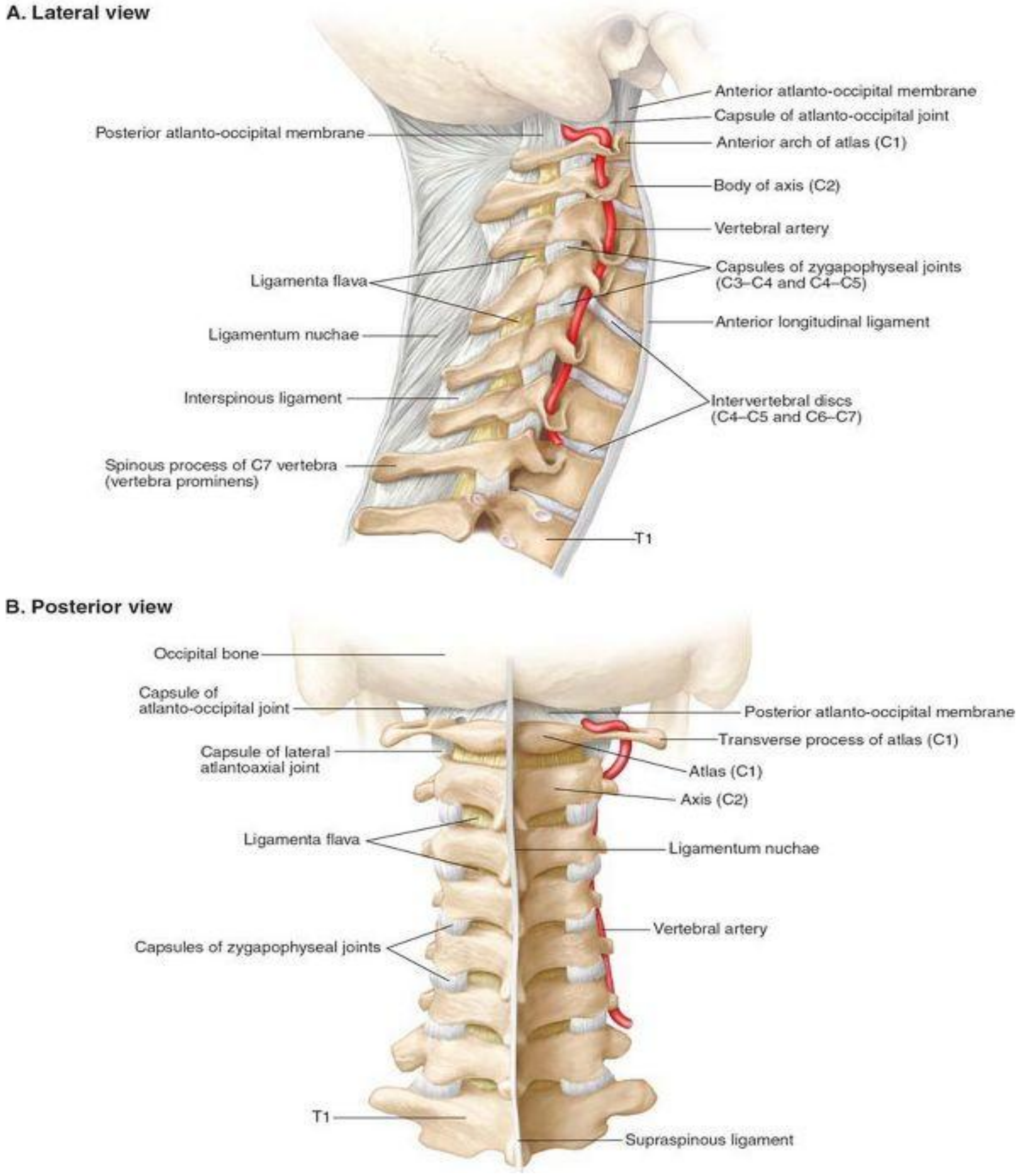

Fig 2 Anatomy of cervical spine

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APPLIED ANATOMY OF ANTERIOR APPROACH TO CERVICAL SPINE

Landmarks in the neck region [5]

- Hard palate-arch of Atlas C1
- Lower border of mandible - C2-C3 level
- Hyoid bone- at the level of C3
- Thyroid cartilage- C4-C5level
- Cricoid cartilage- C6
- Carotid tubercle- C6

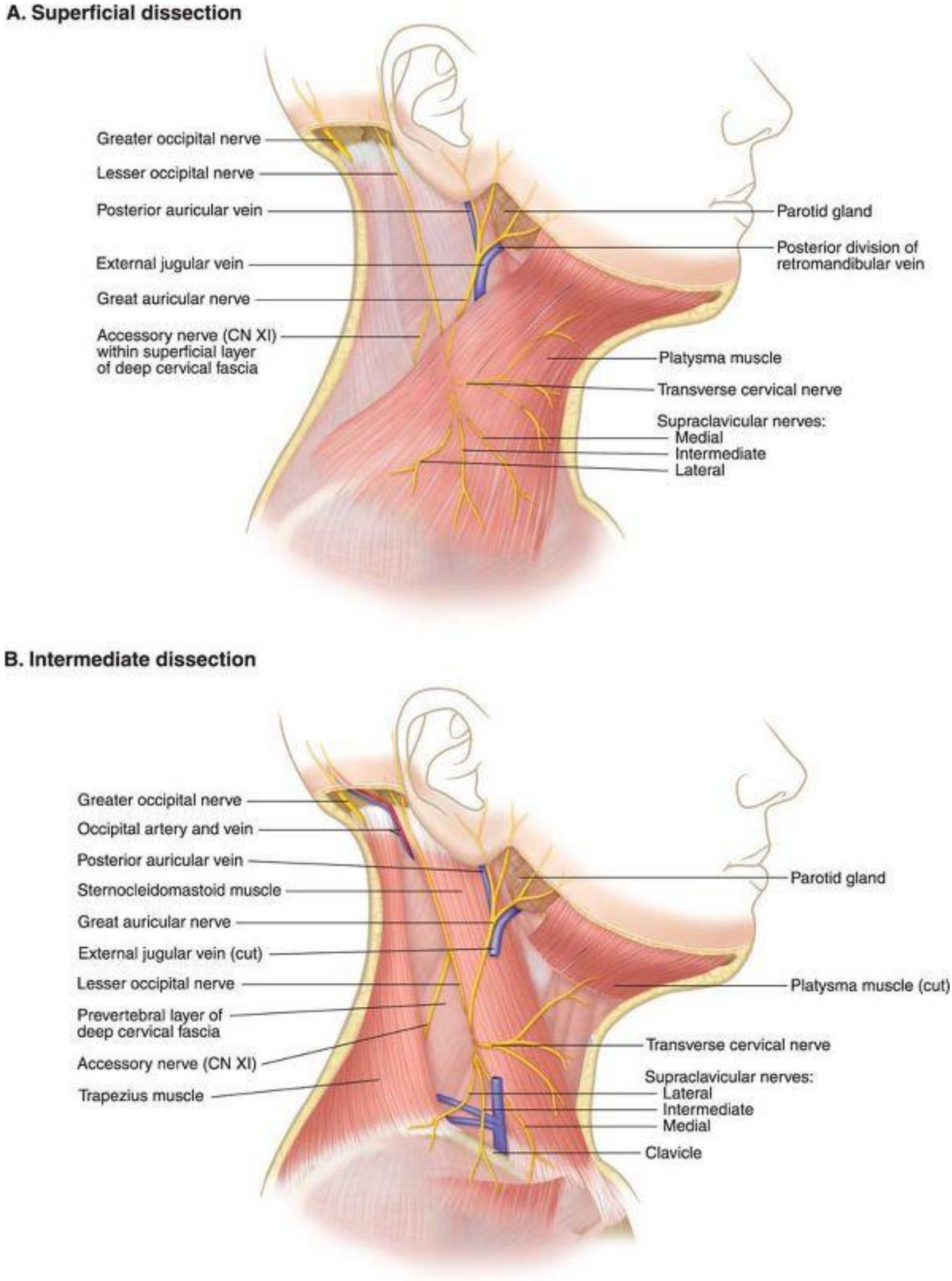


Fig 3 Surgical anatomy of cervical spine

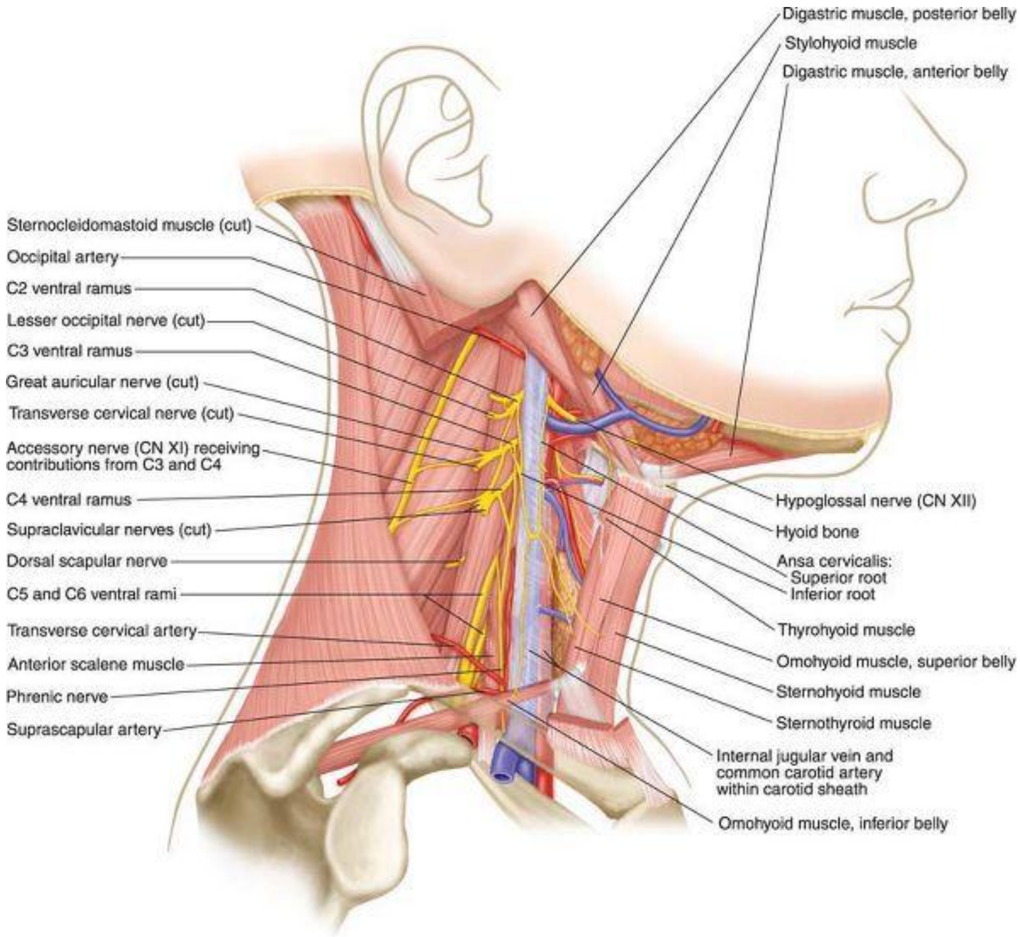


Fig 4 Surgical anatomy of cervical spine

FASCIAL LAYERS IN THE NECK

1)Investing layer of deep cervical fascia-envelops sternocleidomastoid and trepezius muscles.

2) Pre tracheal fascia-invests the strap muscles. It is related to the carotid sheath. Superior &inferior thyroid vessels run from the carotid sheath through the pre tracheal fascia into mid line.These may be divided to enlarge exposure.

3) Prevertebral fascia-It lies in front of prevertebral muscles,and forms the floor of posterior triangle of neck.

Posterior Approach to the Subaxial Cervical Spine

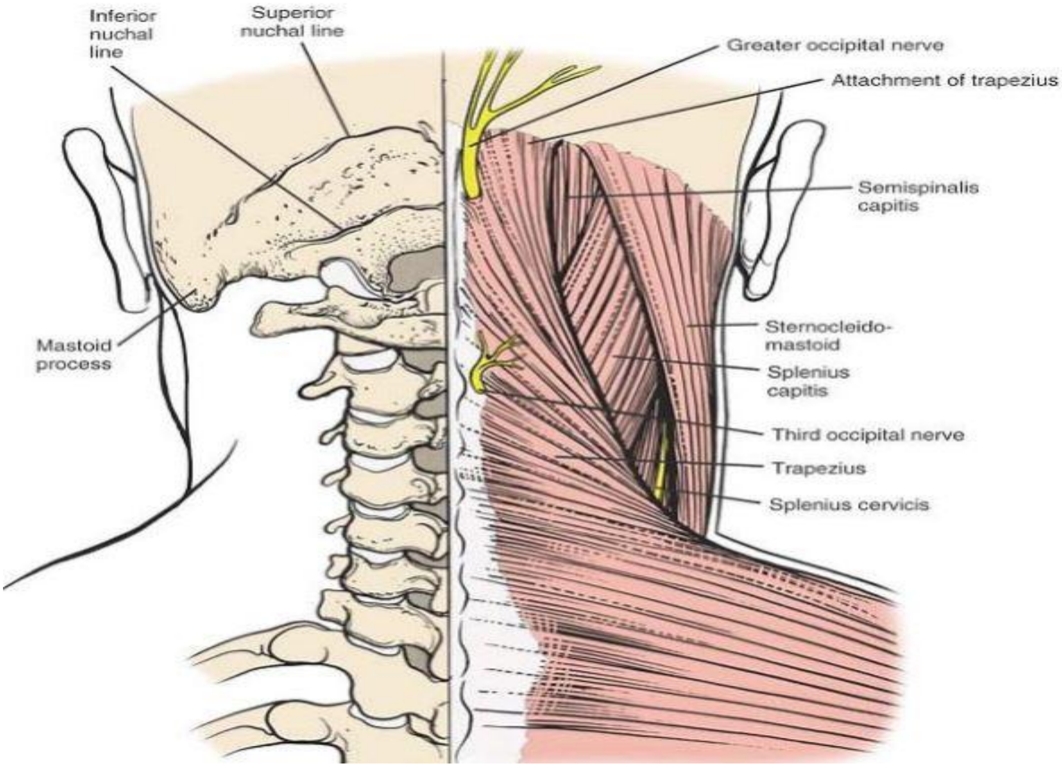
Muscles covering the posterior aspect of the cervical spine run longitudinally and are supplied segmentally. . The approach itself is in the midline, it disturbs no vital structures and is relatively safe. The spinous processes from C2 to C6, are bifid. C7 is thicker, is not bifid.

Superficial Surgical Dissection

Straight incision in the midline of spinous process. Remove the paraspinal muscles subperiosteally from the posterior aspect of the cervical spine either unilaterally or bilaterally, depending on the exposure needed. Use a Cobb elevator or cautery, which can remove the muscles from the bone without damaging them unduly . Carry the dissection as far laterally as necessary to reveal the lamina and the facet joints.(5)

Deep Surgical Dissection

Identify the ligamentum flavum that runs between the laminae. remove it from the leading edge of the lamina of the inferior vertebra, separating the ligamentum from the underlying dura. Perform a laminectomy, either partial or complete, to see the blue-white dura, . Identify the posterior portion of the vertebral body, the disc space, and the possibly herniated disc and proceed.



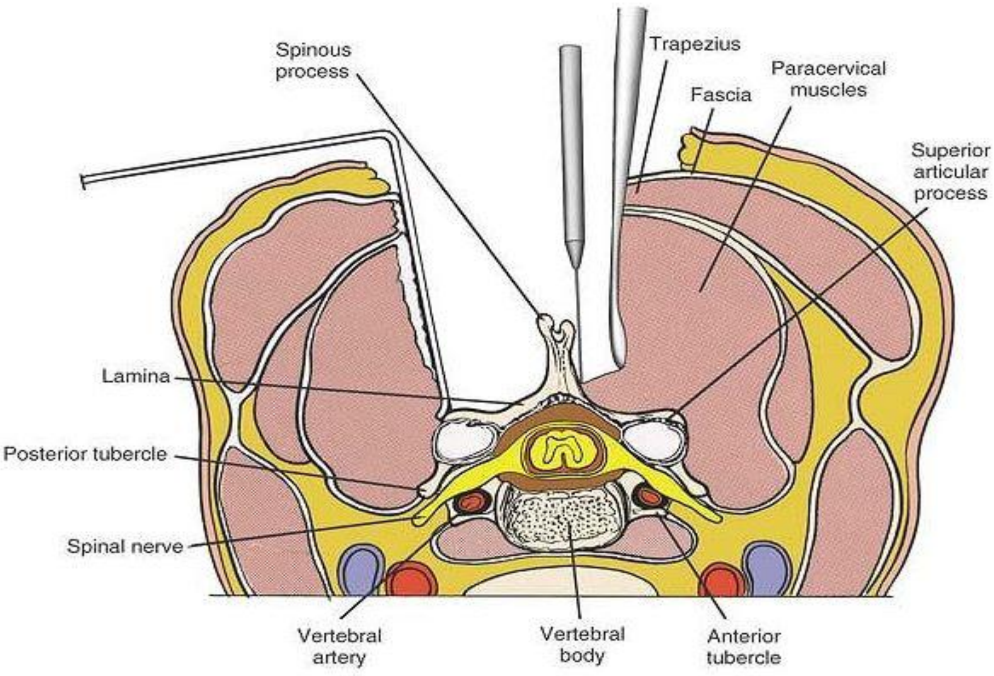


Fig 5 Surgical anatomy of cervical spine, superficial and deep dissection

BIOMECHANICAL STABILITY OF THE CERVICAL SPINE

KINEMATICS OF CERVICAL SPINE

In spinal kinematics, the motion is usually described in relation to adjacent vertebra. The secondary coordinate system may be established in the body of adjacent vertebra.

The spine is a mechanical structure. The vertebrae articulate with each other in a controlled manner through a complex of pivots (facets&discs) , levers(vertebrae), activators (muscles) and passive restrains (ligaments) . The major portion of mechanical stability of spine is due to highly developed, dynamic neuromuscular control system.

STRUCTURES ALLOWING MOTION.

The subaxial (below C2) spine contributes about 50% of flexion-extension and rotation of cervical spine.The orientation of posterior facet joints(45 degree angle in the coronal plane) allows for more mobility than its possible in the other spine regions.Motion at the facet joints is also complemented by concomitant motion between vertebral bodies through the intervertebral discs in between .The uncovertebral joint,not a true diarthrodial joint also contributes to cervical mobility.

STRUCTURES RESISTING COMPRESSION & DISTRACTION

Compressive forces applied in an axial mode are supported or resisted by the vertebral body,the intervertebral disc,the uncovertebral joints of anterior and middle columns,and the facets and lateral masses of the posterior column.It is a tripod of support made up primarily of the vertebral body and two lateral masses with associated facet joints.

The ligaments of the cervical spine function primarily to provide resistance to distractive forces. Distraction of the anterior column and posterior column is limited by anterior ligamentous complex,and posterior ligamentous complex respectively.

STRUCTURES LIMITING MOTION

Because movement of neck places both compressive and distractive forces on the cervical spine ,both the bony & ligamentous structures assist in limiting motion. During flexion,compression occurs in anterior column,distraction occurs in posterior column. Hence flexion is limited by vertebral body,intervertebral disc and posterior ligamentous complex. Likewise extension places compressive forces on posterior column and distractive forces on anterior column. Hence resistance to extension is provided by lateral mass or facet complex and anterior ligamentous complex.Lateral flexion to one side is limited by contralateral facet capsule and by ipsilateral vertebral body and lateral mass or facet complex.

RANGE OF MOTION.

Flexion and extension are free and tends to be greater at C5C6 &C6C7 interspace where they total 17 degree and 16 degree respectivel. Lateral bending and rotation are most free at C3C4 &C4C5 levels where they total 11 degree. Neck movements diminishes with aging . Forward flexion should normally allow chin to touch the chest.Extension can sometimes allow skull to touch the back.In lateral flexion,ear should touch the shoulder.(6)

In general, the osseous anatomy of the lower cervical spine provides little intrinsic stability. This is well demonstrated in cases of severe bifacetal dislocations, where the soft tissues of anterior disc ,capsule and posterior ligamentous complex have been completely disrupted. Such cases are highly unstable, despite the absence of injury to the osseous structures of the cervical spine. Hence, the non osseous structures of the lower cervical spine, such as the ligaments and intervertebral discs, are important stabilizing structures.[6]

ANATOMIC ELEMENTS OF THE SUB AXIAL CERVICAL SPINE

The anterior elements include the anterior longitudinal ligament (ALL), intervertebral disk, vertebral body, intertransverse ligament, and posterior longitudinal ligament (PLL). The ALL is a multilayered ligament that runs along the anterior aspect of the vertebral bodies and disc. The superficial fibers of the ALL cross multiple levels, and the deeper fibers are associated with a single motion segment. In this ventral position, the ALL and the anterior collagen fibers of the annulus fibrosus are important restraints to extension forces. It is important to recognize that the structure of the cervical intervertebral disk is substantially different from that of its lumbar counterpart. Mercer and Bogduk demonstrated that the cervical annulus fibrosus is thick anteriorly, thins as it approaches the uncinate processes, and is very thin posteriorly.This gives it a crescent-shaped appearance when viewed axially, quite unlike the typical “jelly-doughnut” appearance of the lumbar disc. In contrast to the lamellar pattern of a lumbar disc, the anterior annular fibers of the cervical disc are vertically and obliquely oriented in an interwoven fashion, akin to an interosseous ligament between the two end plates.This serves as an important restraint to hyperextension, in conjunction with the confluent ALL. Because the anterior annular fibers are shorter and deeper than the multilayered ALL, they fail in extension before the ALL,thus explaining how disruption can occur through the anterior disk without apparent mechanical failure of the ALL. In severe hyperextension injuries, however, the two structures fail together.

Because the posterior annulus fibrosus is thin, it is unlikely to serve as much of a restraint to flexion forces. The PLL, however, covers the floor of the cervical canal and reinforces the posterior annulus. Like the ALL, the PLL is also a multilayered structure, with the deep layers adhering to adjacent vertebral bodies and the superficial layers crossing multiple levels. Throughout the subaxial cervical spine, the PLL is similar to the ALL in terms of its strength and biomechanical properties, and thus is likely to resist bending moments similarly. At each level of the cervical spine, the PLL is slightly wider than the ALL.However, neither the PLL nor the posterior annulus reinforces the region posterior and superior to the uncinate process in the posterolateral corner—an anatomic feature that may predispose to disc protrusions through this area.[4]

POSTERIOR ELEMENTS OF THE SUBAXIAL CERVICAL SPINE

The posterior elements lie posterior to the PLL. It includes the facets, laminae, facet capsules, ligamentum flavum, and spinous processes. The ligamentum flavum runs from the antero inferior surface of one lamina to the posterosuperior surface of its subjacent lamina. At approximately 5 mm in thickness, the ligamentum flavum in the cervical spine is thinner than that of the thoracolumbar spine. Its elastin content gives elastic properties that promote extension and restrict flexion. How effectively the ligamentum flavum restrains motion likely changes as it degenerates with age and becomes thicker and stiffer, and it may itself contribute to dorsal spinal cord compression during cervical hyperextension.

The capsules of facet joints are relatively thin and more patulous than those of the thoracolumbar spine. The capsule bridges the osseous lateral mass on either side of superior and inferior articular surfaces and is thinnest posteriorly and thickest along its anterolateral region.(4)

In a cadaveric model, Onan and co-workers demonstrated that the lower cervical facets were highly mobile, and when the facets were isolated by removing them from the surrounding lamina and vertebral body, the facet capsules by themselves did little to restrict joint motion due to their laxity. In fact, capsular strain was not observed in flexion until the joint had almost dislocated anteriorly. This suggests that the facet capsules act as a posterior restraint to flexion only at the extremes of facet motion and are thus less frequently injured. Panjabi and colleagues supported this motion in simulations of frontal impact, during which the cervical spine rapidly flexes forward when the “torso” decelerates. They found that the capsules (and PLL) rarely experienced significant strain during this injury model and thus are not prone to disruption during involving frontal impact. Although these data may suggest that its capsules contribute little to the stability of the sub axial cervical spine, one should be careful not to disrupt the capsules at the non fused levels when performing posterior approaches to cervical spine, as this may lead to subluxation at the level above or below.

The interspinous and supraspinous ligaments run between the spinous processes of each vertebra. They are poorly developed in the cervical spine compared with that of thoracolumbar spine. These ligaments are confluent with the ligamentum nuchae, that extends from the spinous processes to the skin between the external occipital protuberance and the C7 spinous process. The inter spinous and supra spinous ligaments are away from the anterior aspect of the spine, hence they have the longest moment arm to resist bending forces, making them important restraints to flexion. In Panjabi and colleagues' mentioned that in frontal impact simulations, inter spinous and supra spinous ligaments were stretched or disrupted most commonly, even at the lowest impact forces tested. The role of the ligamentum nuchae is overlooked in such biomechanical studies because it is typically removed from the cadaveric specimens prior to testing. Takeshita and associates demonstrated that the ligamentum nuchae indeed contributes as a posterior restraint to flexion, as one might expect from its posterior position.Resection of the ligamentum nuchae alone increased the flexion range of the cervical spine by 28 percent. Further resection of the supraspinous, interspinous, and ligamentum flavum increased the flexion range by 52 percent.(1,4)

INSTABILITY

White and Panjabi defined clinical instability as the "**loss of the ability of the spine under physiological loads to maintain relationships between vertebrae in such a way that the spinal cord or nerve roots are not damaged or irritated, and deformity or pain does not develop"**.[6]. Clinical instability can be defined as any interruption in normal smooth translation of the vertebral biomechanics as evidenced by jerky or excessive spinal movements.. Chronic instability is due to progressive deformity that may cause neurological deterioration, prevent recovery of injured neural tissue, or cause increasing pain or decreasing function.

Table 35-6 -- Checklist for Diagnosis of Clinical Instability in Lower Cervical Spine[6]

Element	Point Value
Anterior elements destroyed or unable to function	2
Posterior elements destroyed or unable to function	2
Relative sagittal plane translation >3.5 mm	2
Relative sagittal plane rotation > 11 degrees	2
Positive stretch test	2
Medullary (cord) damage	2
Root damage	1
Abnormal disc narrowing	1
Dangerous loading anticipated	1

From White AA, Southwick WO, Panjabi MM: Clinical instability in the lower cervical spine: a review of past and current concepts, Spine 1:15, 1976.

White, Southwick, and Panjabi suggested that the motion segment should be considered unstable if all the anterior or posterior elements are not functional. They developed a checklist for the diagnosis of clinical instability of the lower cervical spine in which a score of 5 or more indicates instability.

SUBAXIAL INJURY CLASSIFICATION SCORE (SLIC)

COMPONENTS	POINTS
MORPHOLOGY	
No abnormality detected	0
Compression pattern	1
Burst pattern	2
Distractive pattern	3
Rotational/ Translational pattern	4
DISCOLIGAMENTOUS COMPLEX	
Intact	0
Indeterminate	1
Obvious distruption of ligamentous complex	2
NEUROLOGICAL STATUS	
Intact status	0
Evidence of root injury	1
Complete spinal cord injury	2
Incomplete spinal cord injury	3

Vaccaro et al recommended that an SLIC score = 5 or > 5 should be treated with operative intervention. Information from this table was obtained from Vaccaro et al. (9)

IMPLANTS AND INSTRUMENTS

1. Cervical H-plate
2. 3.5 mm cortical screws
3. Casper pins
4 Casper distractor
5. Stainless steel wire
6. osteotome and mallet
7. Nibbler
8. Graft punch(6)

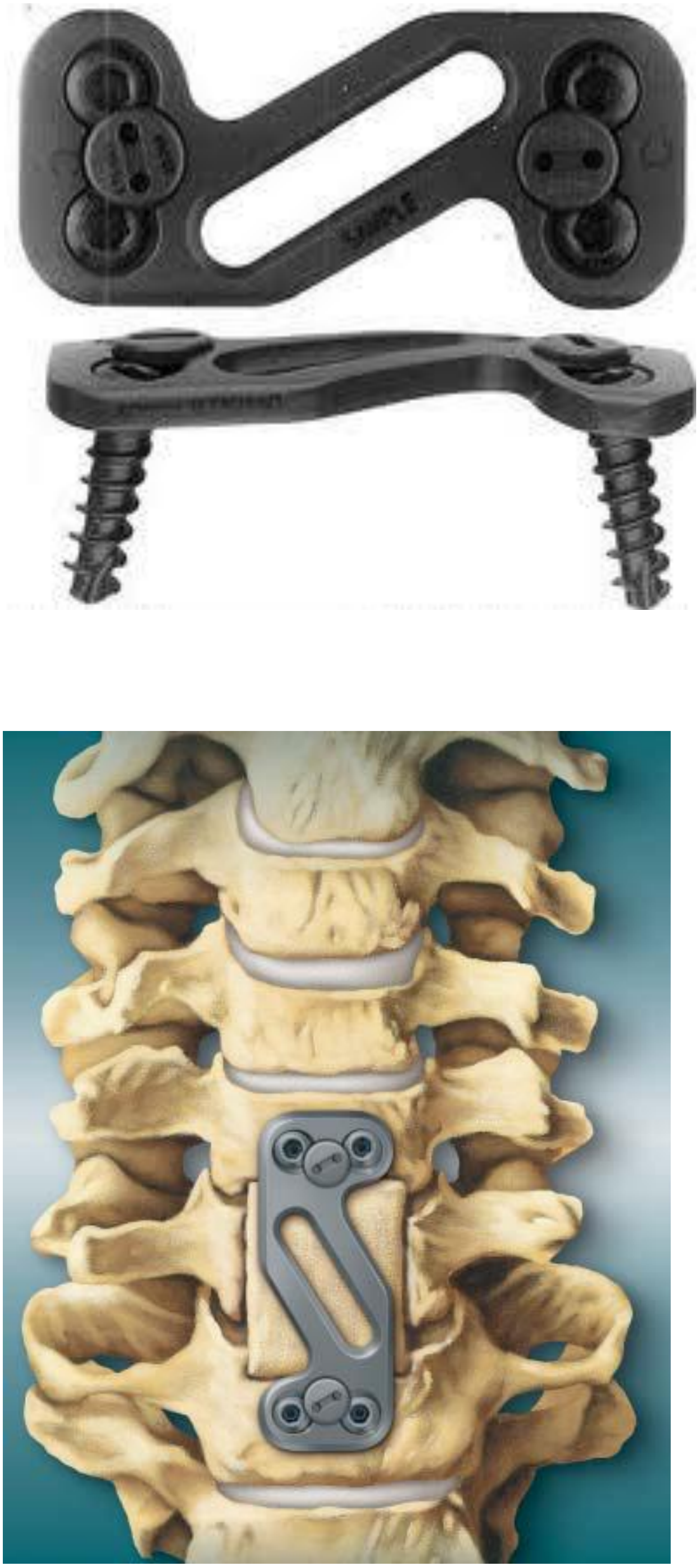


Fig 6 cervical H- plate and screws

INCISION

The preferred approach for anterior stabilisation of spine is Southwick Robinson approach according to Bailey and Badgely[8] ,Southwick & Robinson[7],Cloward[1]. Either transverse and oblique incision can be used. For cosmetic reasons many authors prefer the transverse incision along the Langer's lines.There are various reasons for choosing to operate from the right or left of the patient. Variable course of recurrent laryngeal nerve on right side and its susceptibility of injury favours a left sided approach. Recent investigations suggest that nerve may become trapped between the retractor blades and the endotracheal cuff .Momentarily releasing the cuff pressure after retraction allows the nerve to shift its position and avoid injury.Right handed surgeon tend to approach from the right and opposite is true for left handed surgeon.The thoracic duct is unilateral structure on the left side and as such is susceptible to injury only from the left sided approach.[7,8]

CLASSIFICATION

Numerous classifications of cervical spine injuries have been formulated, but the mechanistic classification proposed by Allen et al[5,9]. seems to be the most complete. In a review of 165 lower cervical spine injuries, they identified the following six common patterns of injury, each of which is subdivided into stages based on the degree of injury to osseous and ligamentous structures.[6,9]

Compressive Flexion—Five Stages

Compressive flexion stage 1—blunting of the anterosuperior vertebral margin

Compressive flexion stage 2— The anteroinferior vertebral body has a "beak" appearance, concavity of the inferior end plate may be increased, and the vertebral body may have a vertical fracture.

Compressive flexion stage 3— Fracture line passing obliquely from the anterior surface of the vertebra through the centrum and extending through the inferior subchondral plate, and a fracture of the beak.

Compressive flexion stage 4—Stage III & posterior translation of upper vertebra measuring <3mm

Compressive flexion stage 5—Posterior translation of upper vertebra measuring >3mm,facet gapping,indicating anterior and posterior ligamentous injury

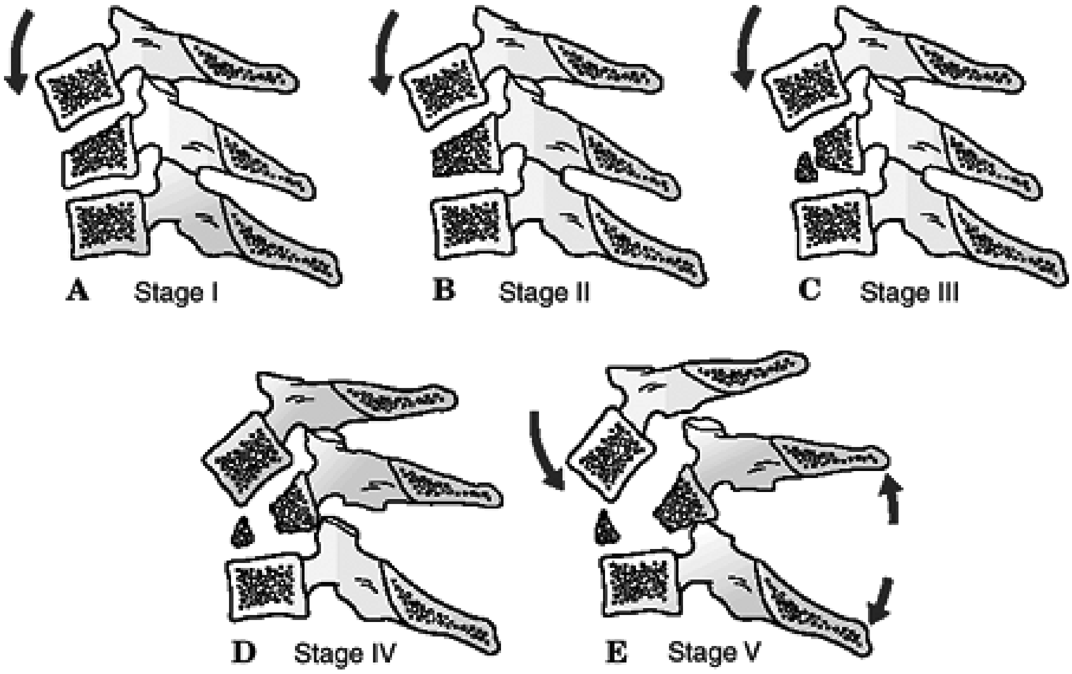


Fig 7 Compressive flexion

Vertical Compression—Three Stages

Vertical compression stage 1—fracture of the superior or inferior end plate with a "cupping" deformity.

Vertical compression stage 2—fracture of both vertebral end plates with cupping deformities.

Vertical compression stage 3— Vertebral body communition with or without retropulsion of fragments,with or without kyphotic or translational deformity.(9)

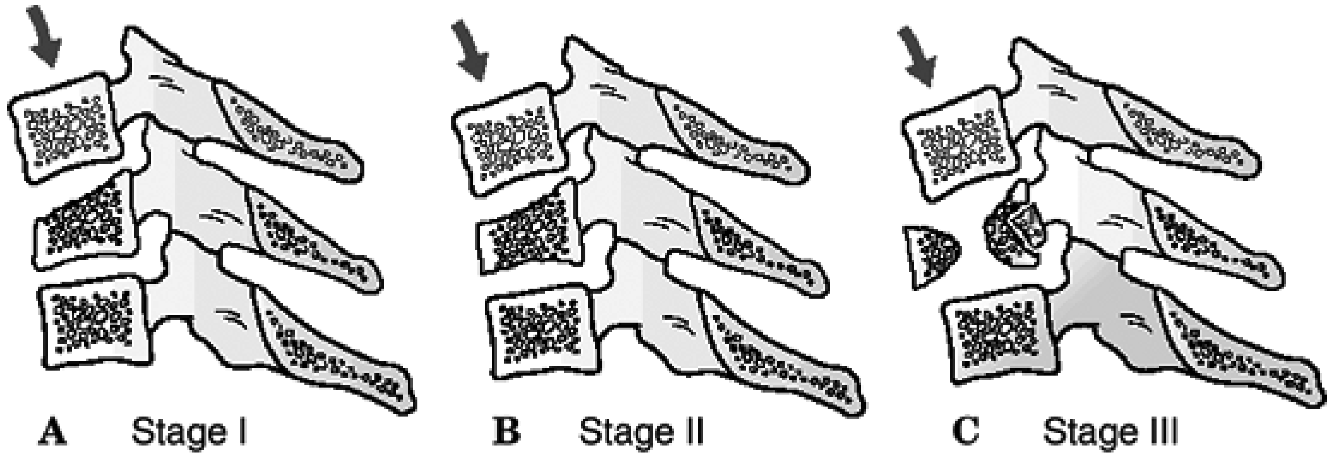


Fig 8 Vertical compression

Distractive Flexion—Four Stages

Distractive flexion stage 1— facet subluxation in flexion, with abnormal divergence of the spinous process.

Distractive flexion stage 2—unilateral facet dislocation

Distractive flexion stage 3—bilateral facet dislocations, with approximately 50% anterior subluxation of the vertebral body.

Distractive flexion stage 4—full vertebral body width displacement anteriorly or a grossly unstable motion segment, giving the appearance of a "floating" vertebra.(9)

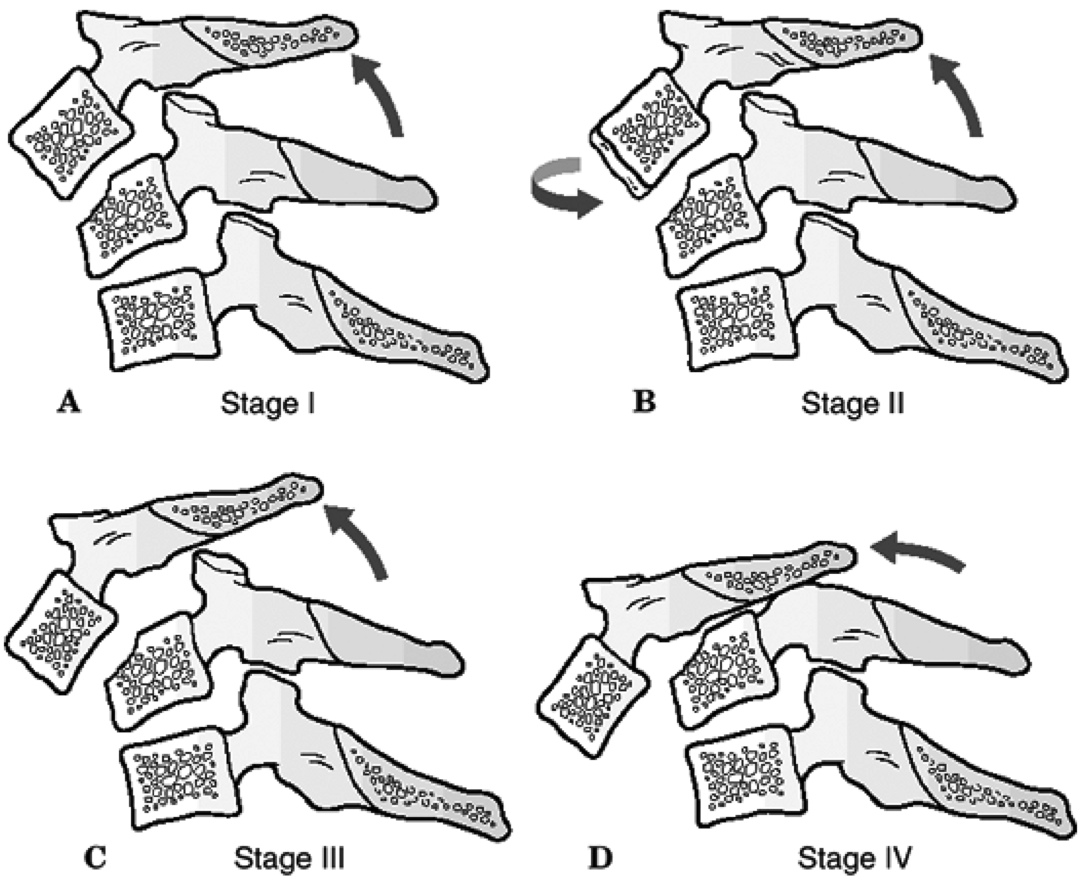


Fig 9 Distractive flexion

Compressive Extension—Five Stages

Compressive extension stage 1—unilateral vertebral arch fracture with or without anterior rotatory vertebral displacement

Compressive extension stage 2—bilaminar fractures without evidence of other tissue failure. Typically, the laminar fractures occur at multiple contiguous levels.

Compressive extension stage 3—bilateral vertebral arch fractures with fracture of the articular processes, pedicles, lamina, or some bilateral combination, without vertebral body displacement.

Compressive extension stage 4—bilateral vertebral arch fractures with partial vertebral body width displacement anteriorly.

Compressive extension stage 5—bilateral vertebral arch fracture with full vertebral body width displacement anteriorly.

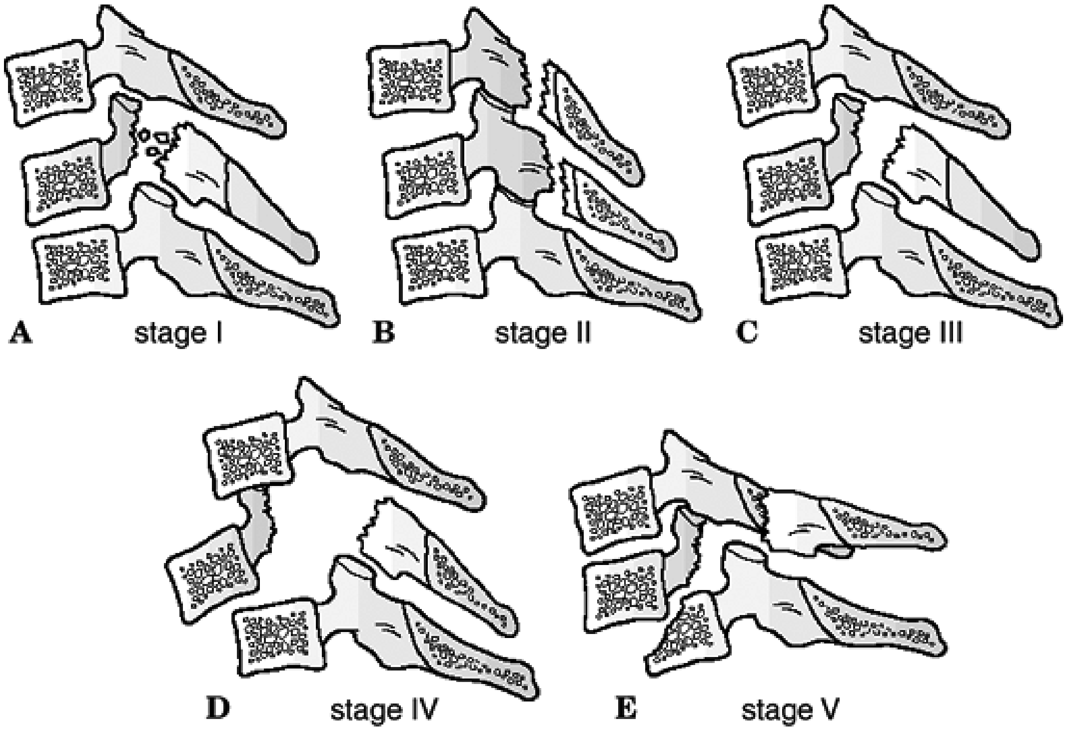


Fig 10 Compressive extension

Distractive Extension—Two Stages

Distractive extension stage 1—Abnormal widening of anterior disc space

Distractive extension stage 2—Stage 1 and posterior translation

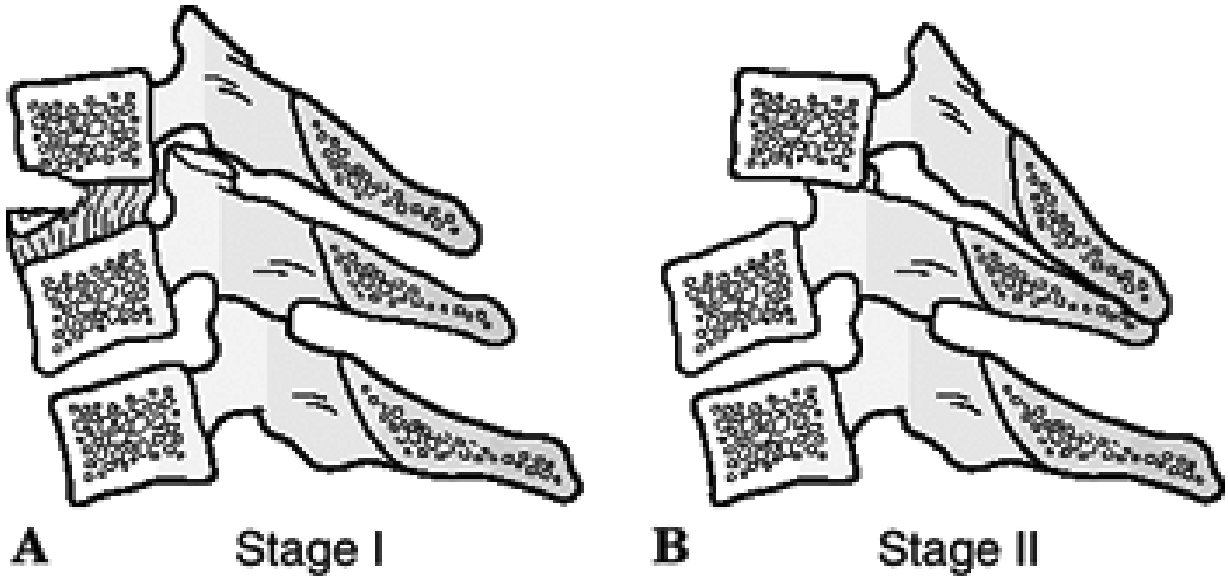


Fig 11 Distractive extension

Lateral Flexion—Two Stages

Stage I-Unilateral uncovertebral fracture or asymmetric vertebral body compression.

Stage II-Vertebral body or posterior arch fractures with lateral translation or unilateral facet gapping,coronal angular deformity noted on an AP X-ray.(9)

.

INVESTIGATIONS

The assessment of cervical spine instability begins with clinical examination ,following imaging of cervical spine should begin with basic conventional radiography.CT,MRI should be reserved after appropriate radiographic and clinical examination.

RADIOGRAPHY

AP view-Recognised structures include vertebral bodies ,superior and inferior end plates , uncinate processes ,disc spaces, ,which together with the inferolateral aspect of adjacent vertebral body can be seen.

Lateral view-recognised structures include vertebral body,disc spaces,U-shaped transverse process superimposed on the vertebral body.articular processes,adjacent facets, interfacetal joints , lamina and spinous processes.

Pull down lateral view- illustrates

1.C7T1, apophyseal joints

2.Superior end plates of T1.

3.Anterosuperior aspect of body of T1

4.Cervicothoracic prevertebral soft tissue shadow

Swimmers view- taken in a position of arms similar to the Australian free style swimming stroke position. It gives osseous superimposition & typically seriously obscures visualisation of middle and posterior columns of the C7 vertebra and even C7-T1 junction.

Right and left oblique view-shows posterolateral aspects of vertebral body,pedicle,and intervertebral foramen.

CT scan-shows the body of the dislocated vertebra anterior the uncinate process and body of the subjacent vertebra and the dislocated anterior masses anterior to the subjacent masses in this configuration,the uncovered superior facets of the subjacent vertebra will be clearly evident

MRI-determines the extent and type of spinal cord injury,presence of other intraspinal pathology,assess ligamentous and disc injury,also assess the status of posterior longitudinal ligament in retropulsion of the disc at the level of injury.

The goal of treatment of the spinal cord injuries

1.Decompress neurological elements.

2.Preserve residual neurologic function and also to improve neurological function.

3.Restore spinal alignment.

4.Restore spinal stability. **(6)**

MATERIALS AND METHODS

STUDY DESIGN.

It is a prospective study involving 17 patients who are all admitted with subaxial cervical spine injuries and amenable to intervention in our Department of Orthopaedics and Traumatology, Goverment Rajaji Hospital, Madurai.

INCLUSION CRITERIA

- 18 – 65 Years of both sex
- Cervical spine injury with instability involving C3 Cervical Level to C7 Cervical Spinal Level (Lower Cervical Spine).
- Traumatic Disc Prolapse impinging the Cord involving C3 Cervical Level to C7 Cervical Spinal Level (Lower Cervical Spine).
- All Patients with cord damage whether Complete or Incomplete cord lesions.

.**EXCLUSION CRITERIA**.

- Medical co morbidities eg: Malignancy, severe liver disease, Organic brain disease
- Multiple injuries that influence the function
- Thoracolumbar spinal injuries
- Previous cervical spine injuries

INITIAL MANAGEMENT

1.Management of Airway,Breathing,Circulation

2.Cervical collar immobilisation

3. Fluid and electrolyte management.

4. Assessment of neurological status by ASIA motor score ,

5. Methyl prednisolone succinate if injury is <8 hours old.Dose-30mg/kg in first 15 minutes,followed by 5.4mg/kg/hr I.V infusion for next 23 hours.

6. Skull tong traction if needed.

7.After stabilisation of patient appropriate X-rays,CT scan,MRI was taken.

8.Cervical injuries were classified by using standard classification system i.e Allen Fergueson classification.

9.Patients were assessed and surgical procedure planned.

PROCEDURE

Anaesthesia-General anaesthesia

Position-Supine position

Incision-Transverse incision or oblique

Fig 11 Position and Incision

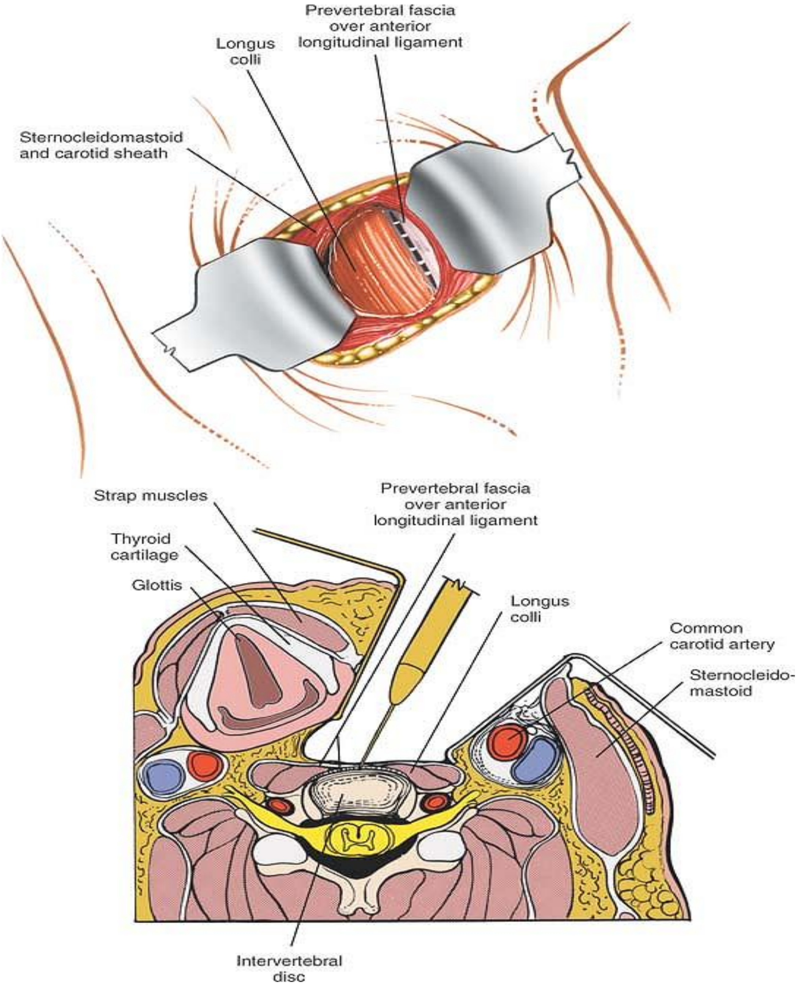


Fig 12 Southwick Robinson approach

Anterior Southwick and Robinson’s approach from right side sandbag placed under the inter-scapular and ipsilateral iliac regions. Both shoulders were tucked down towards the foot end of table. This position ensures hyperextension and thereby better visualization of the cervical spine intraoperatively. Palpation of thyroid,cricoid cartilage corresponding to C3, C4-C5 and C6 level respectively A standard transverse or oblique incision was made. After incising platysma ,anterior border of sternocliedo mastoid muscle was identified. Superficial layer of deep cervical fascia was incised, carotid pulsations were palpated and SCM along with carotid sheath was retracted laterally while trachea, eosophagus and thyroid were retracted medially. Deep layers of deep cervical fascia overlying Longus colli muscles were divided bluntly. Longus colli were reflected sub periostealy.(7)

A thin needle bent at 90 degrees was placed in appropriate disc space and lateral radiograph was taken to verify the exact level. Anterior longitudinal ligament and annulus over disc were incised and disc taken out End plates of adjacent bodies were removed and space for graft was prepared. Spaces were packed with gel foam and wound was covered with a clean sponge.For corpectomy the body of vertebra excluding lateral cortices was removed

A Tricortical graft harvested from iliac crest equal to measured dimensions and was fashioned into a wedge to maintain cervical lordosis .Then the graft is placed either corpectomy or discectomy space. A lateral radiograph was taken to check position of graft. The anterior cortex was drilled by 2.5 mm bit and appropriate size cervical H- plate was placed and screws of 14-18 mm were used and directed towards midline .

Position of screw was checked with C-arm and then diagonally, opposite locking screw was then placed. Position of screws and plate was again checked with C-arm. After ensuing proper haemostasis, platysma, subcutaneous tissue and skin were closed in layers without drain and a cervical collar was applied and patient was extubated.(6)

POSTERIOR INTERSPINOUS WIRING

Wiring techniques offer the advantages of ease of application and safety. In addition, they may be used to enhance other posterior fixation techniques. A hole is made on each side of the spinous process at its base, and a towel clamp is used to connect the holes. A 1.2-mm wire is passed through the hole, brought around the spinous process of the lower level, and tightened. After decortication of the arthrodesis segment, bone graft is added and the wound is closed over a suction drain.(10)

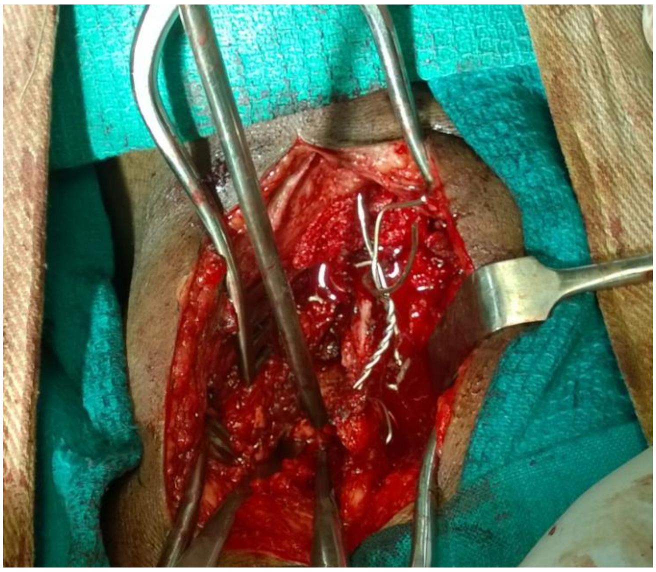


Fig 14. Intra operative picture of posterior interspinous wiring

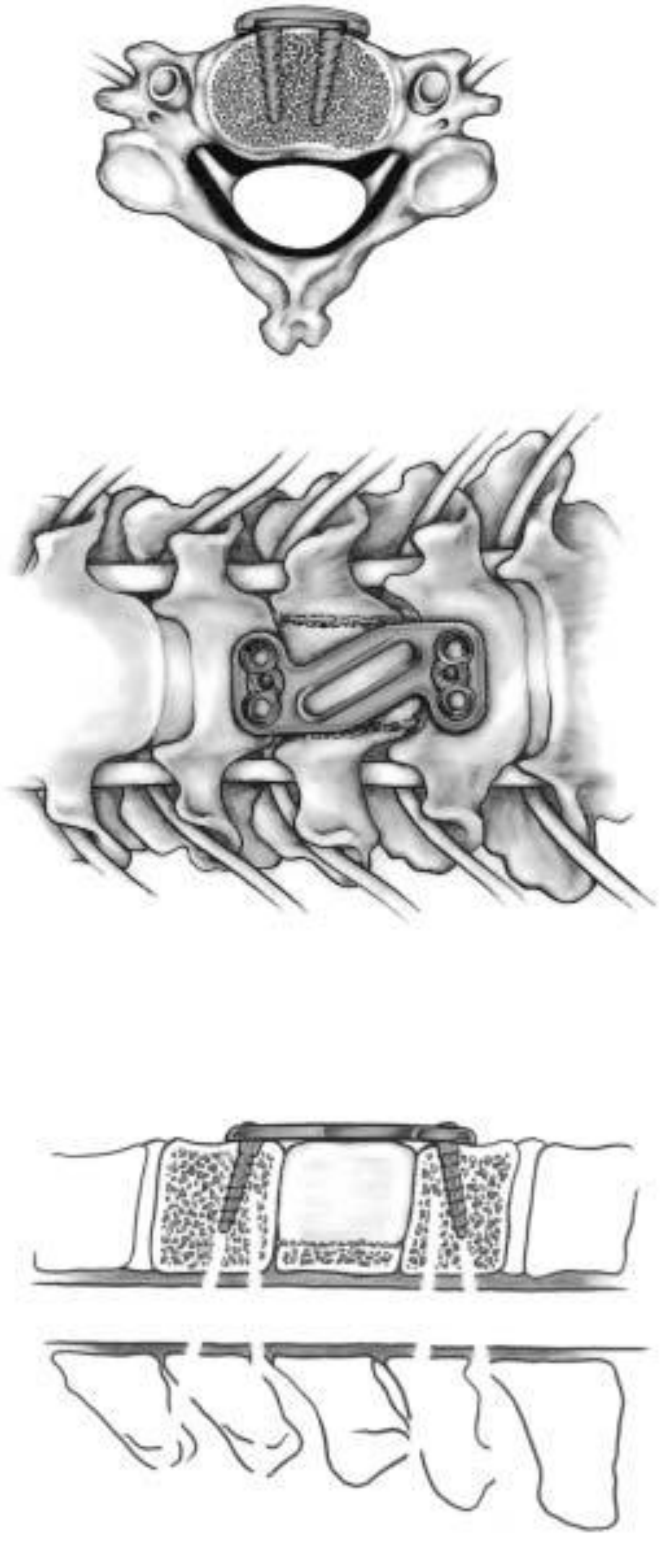


Fig 14 Placement of plate and screw

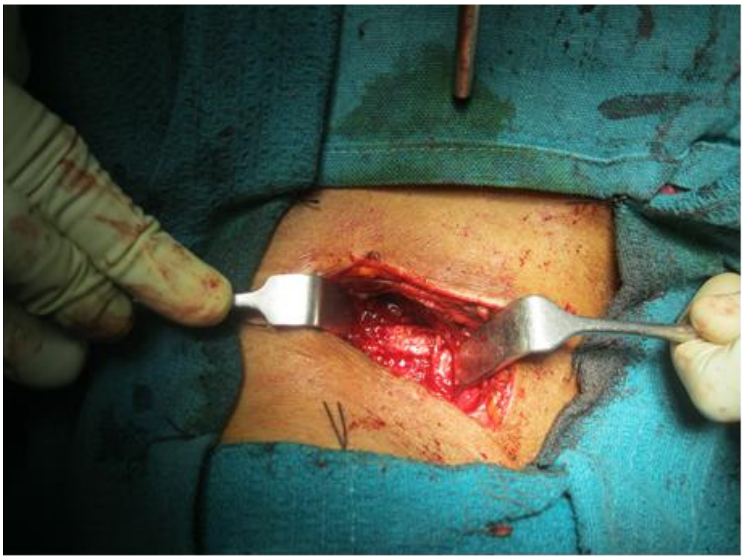


Fig 15 Intraoperative images showing bone graft in situ

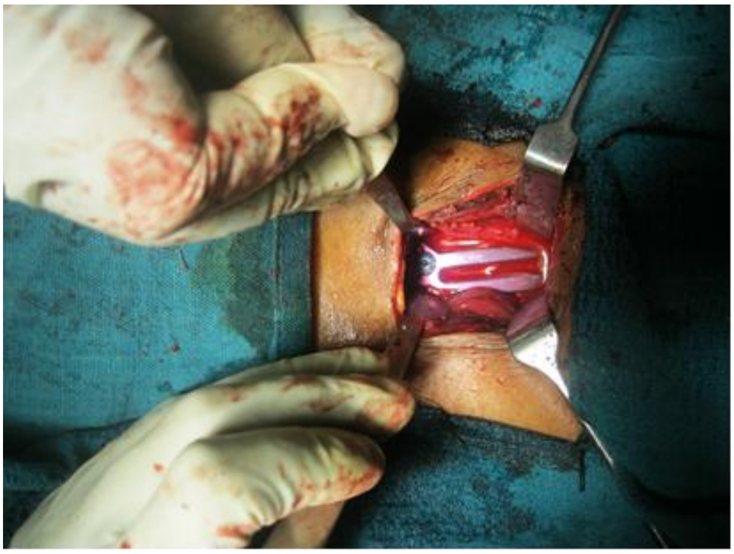


Fig 16 Intra operative image shows plate in situ.   C-arm image intensifier

POST OPERATIVE PROTOCOL

1..Patients were allowed take liquid diet once the bowel sounds appears.

2.Post operative X-rays were taken.

3.Intravenous antibiotics were given for 7 days.Oral antibiotics were given for 7 days.

4. Periodic neurological examinations were conducted.

5.Physiotherapy in the form of Active/Passive mobilisation was continued.

6.Bladder,Bowel,Back care was continued.

7.Sutures removed and patients were discharged with collar on 3rd week.

8.The follow-up examinations and X-Rays with the patient reporting at an interval of 6 weeks for first 3 months and thereafter every 3 months. The final result were analysed on the basis of following criteria:

1. Neurological recovery as per ASIA scale, bone fusion, stability assessment.

OBSERVATIONS

AGE INCIDENCE

Age of the patients ranged from 19 to 62 years. Mean age was 43.5 years

Age(years)	No.of patients	Percentage
11-20	1	5
21-30.	2	10
31-40	4	20
41-50	8	40
51-60.	4	20
61-70	1	5

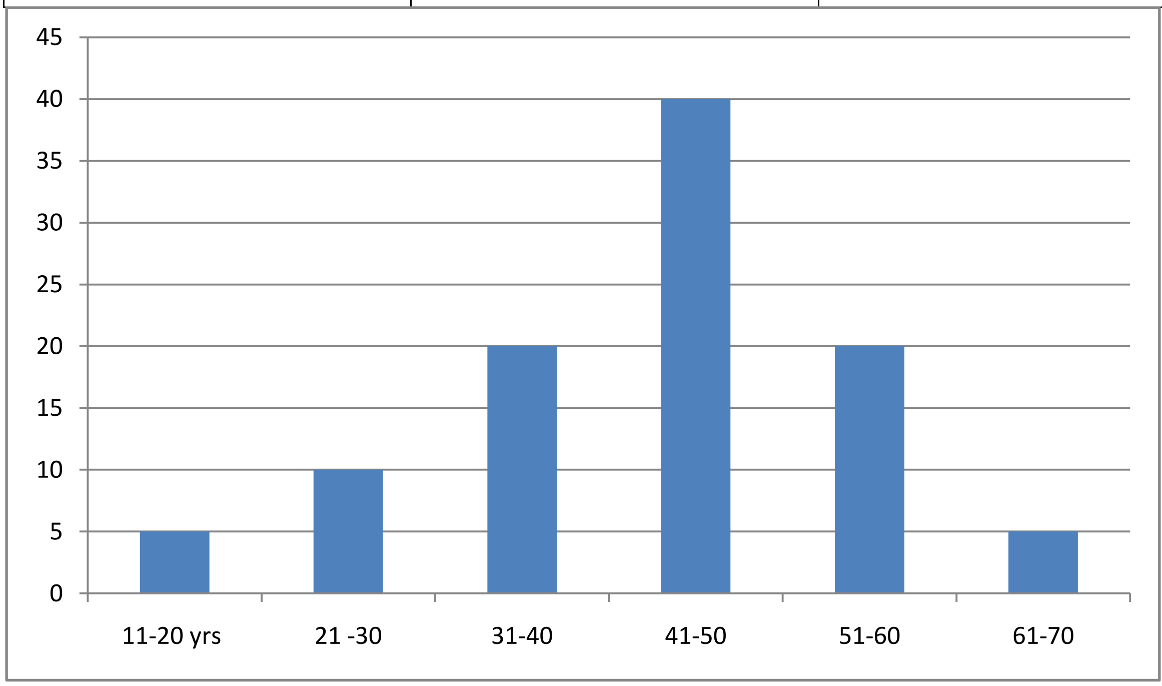


Chart 1 Age incidence

SEX INCIDENCE

Sex	No.of patients	Percentage
Male	20	100
Female	0	0

Table 1 Sex incidence

MODE OF INJURIES

Mode of injury	No. of patients	Percentage
Road traffic accident	7	35
Fall from height	10	50
Fall with weight on back	2	10
Slip and fall on ground level	1	5

Table 3 Mode of injuries

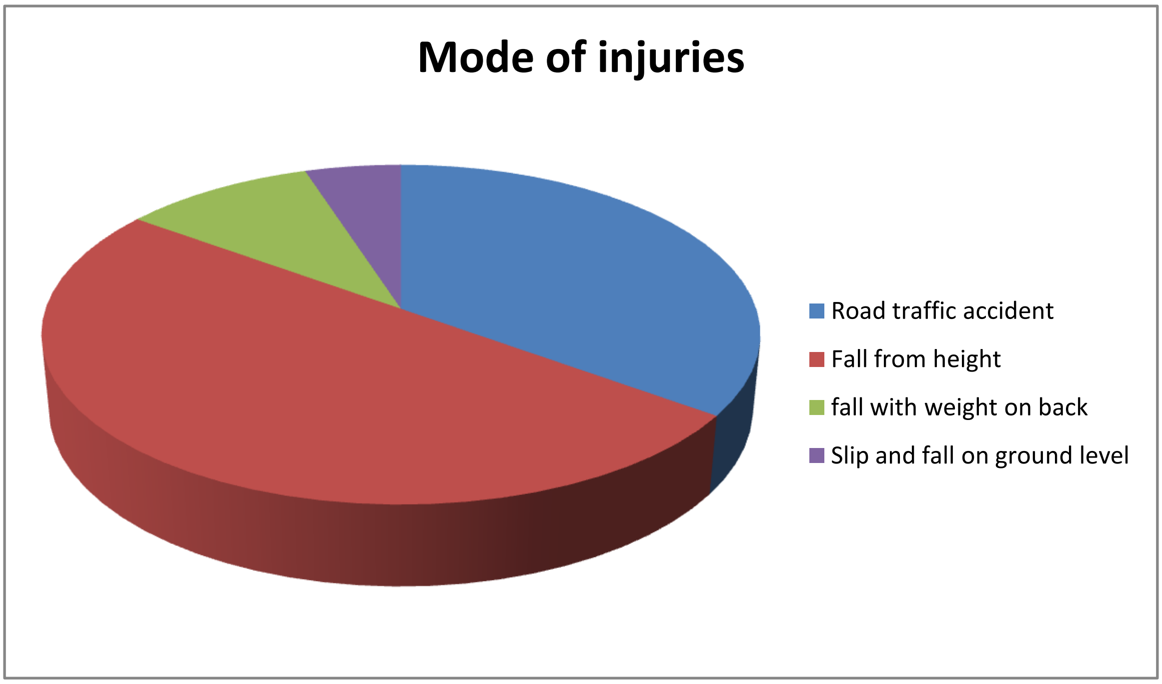
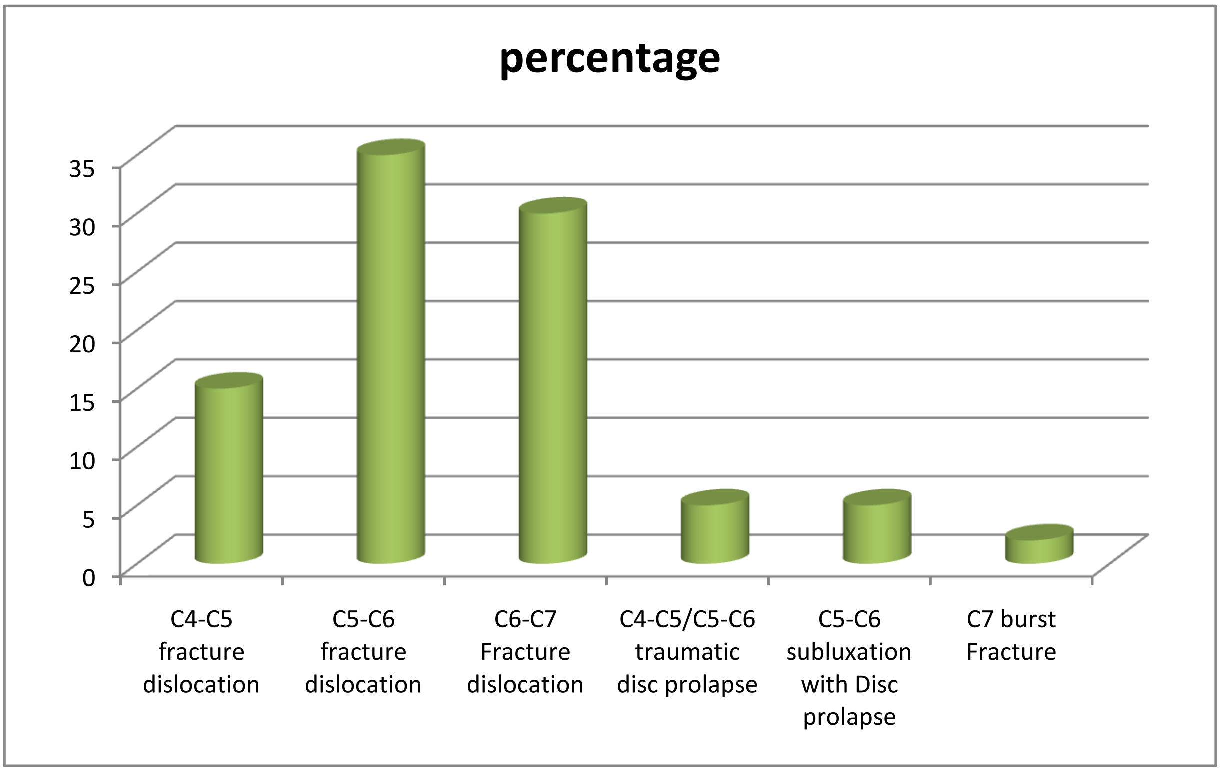


Chart 3 Mode of injury

TYPE OF INJURIES

Type of injury	No.of patients	percentage
C4-C5 fracture dislocation	3	15
C5-C6 fracture dislocation	7	35
C6-C7 fracture dislocation	6	30
C4-C5/ C5-C6 traumatic disc prolapse	1	5
C5-C6 subluxation with disc prolapse	1	5
C7 burst fracture	2	10

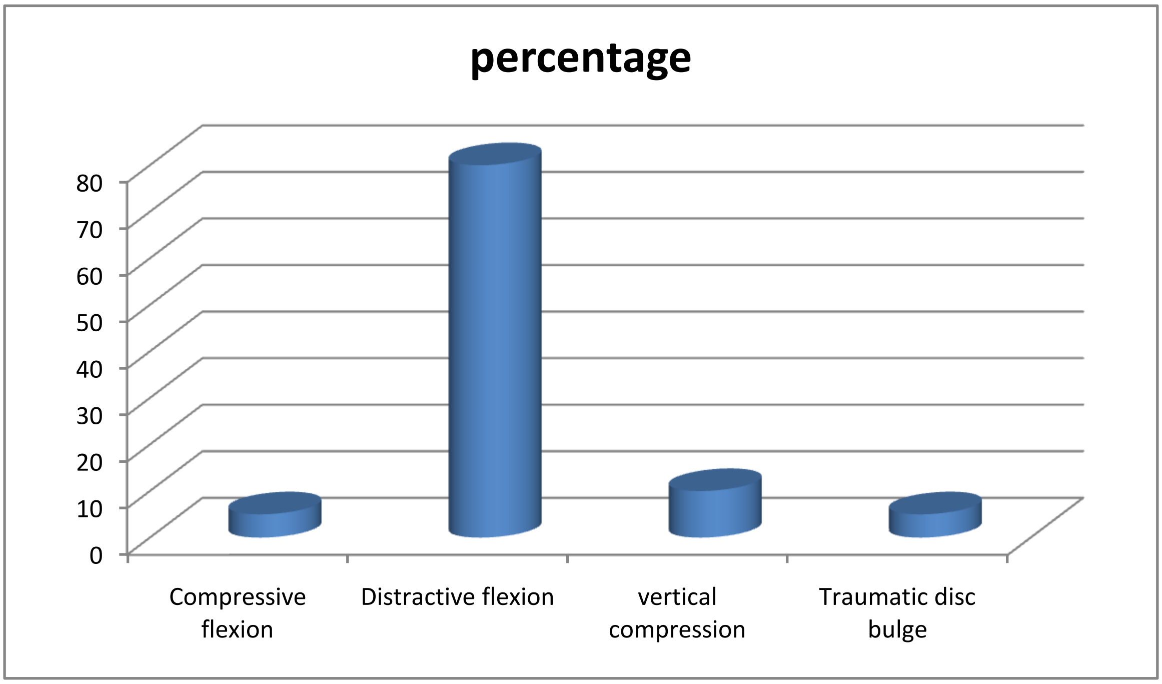
Table 4 Type of injuries



CLASSIFICATION

Classification type	No.of patients	percentage
Compressive flexion	1	5
Distractive flexion	16	80
Vertical compression	2	10
Traumatic disc bulge	1	5

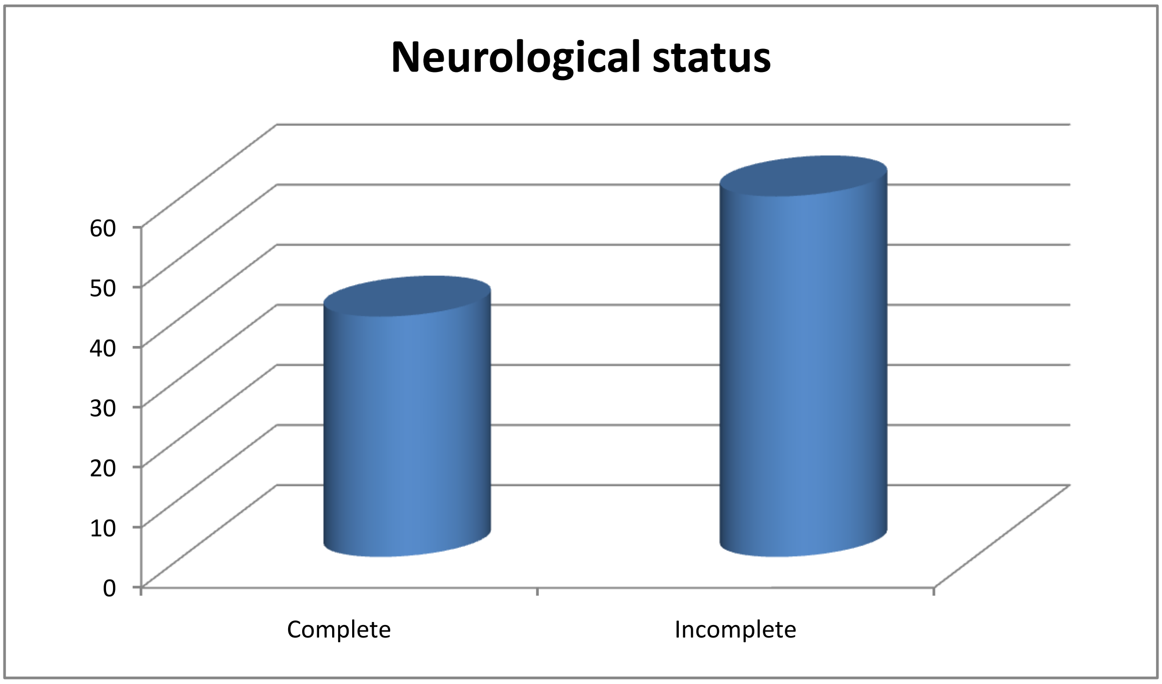
Table 5 Classification



NEUROLOGICAL STATUS

Neurological deficit	No.of patients	percentage
Complete	8	40
Incomplete	12	60

Table 6 Neurological status

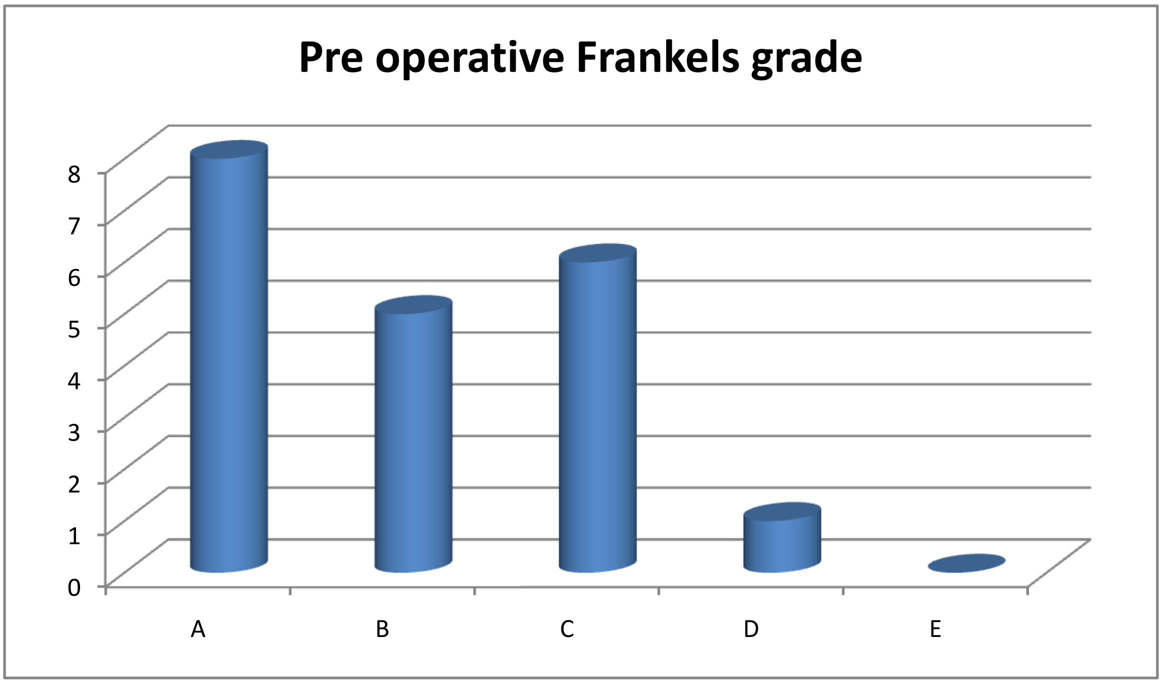


Bar diagram - Neurological status

PRE OPERATIVE FRANKELS GRADE

Pre-op frankels grade	No.of patients
A	8
B	5
C	6
D	1
E	0

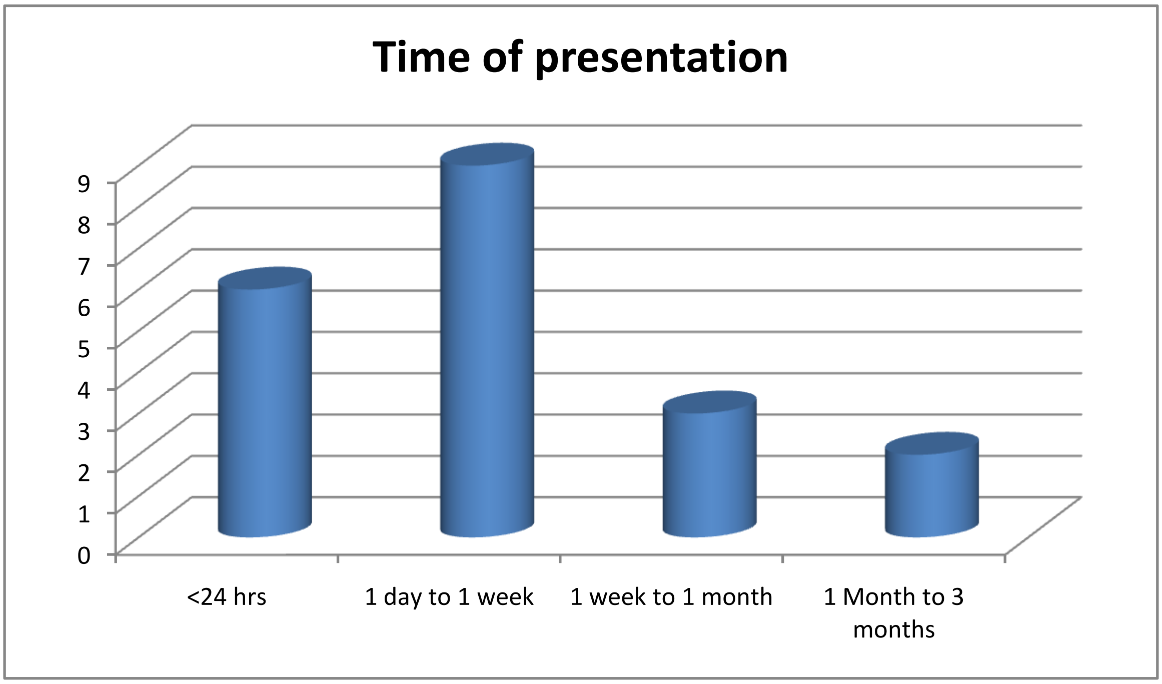
Table 7 pre operative Frankels grade



TIME OF PRESENTATION

Time of presentation	No.of patients
Within 24 hours of injury	6
1 day to 1 week	9
1 week to 1 month	3
1month to 3 months	2

Table 8 Time of presentation



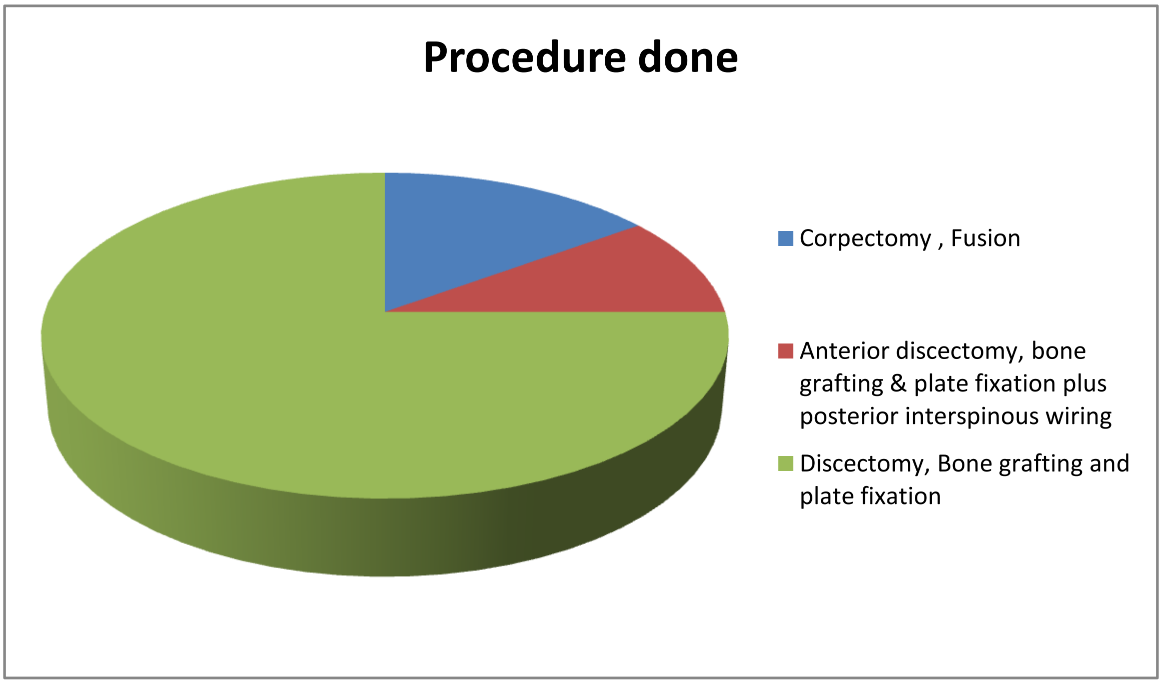
TIME INTERVAL

Time interval from admission to surgery was 3 days to 23 days

PROCEDURE DONE

Procedure done	**No.of patients**
Corpectomy ,bone grafting and plate fixation	3
Anterior discectomy,bone grafting and plate fixation plus posterior interspinous wiring	2
Discectomy,bone grafting and plate fixation	15

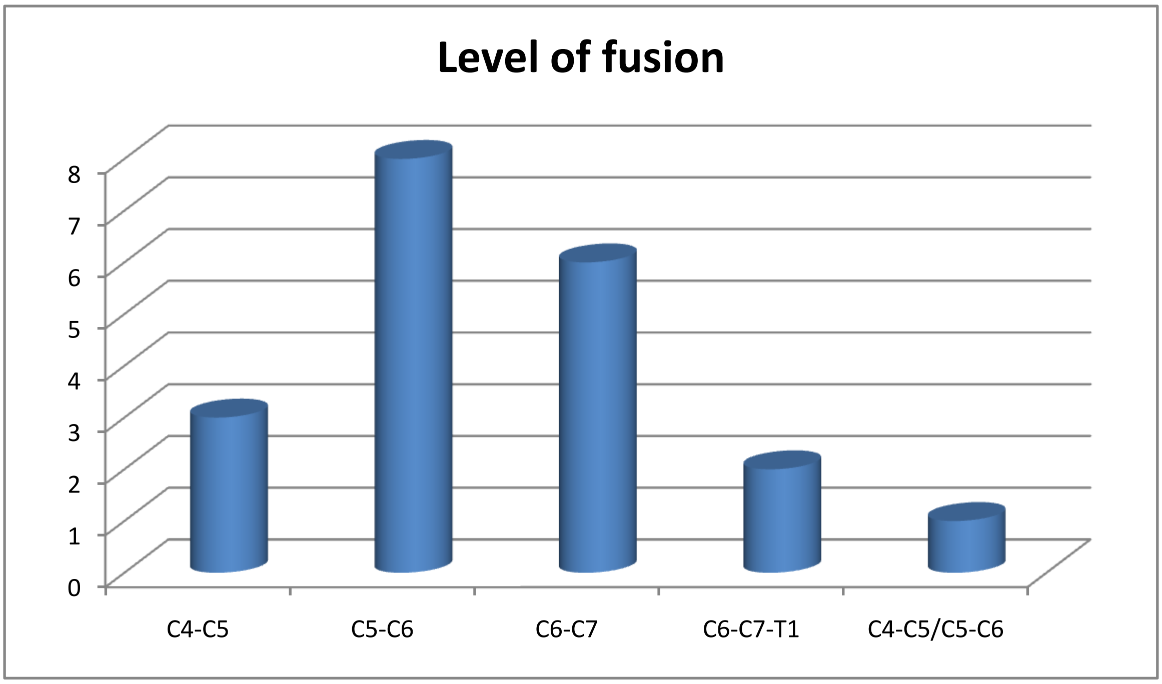
Table 8 procedure done



LEVEL OF FUSION

Level of fusion	No.of patients
C4-C5	3
C5-C6	8
C6-C7	6
C6--T1	2
C4-C5/C5-C6	1

Table 9 Level of fusion



FOLLOW UP

X -rays were taken immediate post operative period,6 weeks interval for first 3 months thereafter every 3 months..

Neurological status was analysed using frankels grade on each visit.

COMPLICATIONS

Totally 3 cases were expired. Two cases was due to acute respiratory distress syndrome. One case due to aspiration pneumonitis. Four patients developed bed sores in which one case developed bed sore preoperatively and others postoperatively. One patient who had grade 3 sacral sore underwent flap cover with the help of plastic surgeon intervention. Other 3 patients managed conservatively.

ANALYSIS OF RESULTS

Results were analysed during follow up using following criteria

1) Pain

2) Neurologic recovery using frankels grade

3) Fusion rate

4) Stability of spine

The neurologic status was assessed using **Frankels** grade

Type	Characteristics
A	Absent motor and sensory function
B	Sensation present and motor absent
C	Sensation present and motor active but not useful grade i.e $<3/5$
D	Sensation present and motor active and useful i.e $\geq 3/5$
E	Normal motor and sensory function

Table 10 Frankel's grade

The results are graded as

Good:

- No neck pain
- Sound fusion at the desired level
- Good stability of the spine
- Complete or partial neurologic recovery

Fair

- Moderate neck pain which does not restrict the day to day activities.
- No recovery of neurologic deficit
- Poor fusion at the desired level
- Good stability of the spine

Poor

- Severe neck pain
- No recovery or worsening of the neurologic deficit
- Pseudoarthrosis
- Unstable spine

RESULTS

- In this study all the cases are male with most of the patients are in the age group of 41-50 years.
- Fall from height is the most commom of injury followed by road traffic accident.
- C5-C6 # dislocation is most common spinal injury pattren.
- Incomplete neurological deficit are more in this study.
- Most of the cases are flexion distraction type of violence .
- Most of the cases presented with in one week of injury.
- Only 2 cases of 20 cases operated by global fusion ,both of them are presented late and found to have locked facets.
- 2 out of 3 cases are expired from complete neurological deficit.
- Mobilisation of neck started after 6 weeks.

COMPLICATIONS:

Totally 3 cases were expired. Two cases was due to acute respiratory distress syndrome. One case due to aspiration pneumonitis. Four patients developed bed sores in which one case developed bed sore preoperatively and others postoperatively. One patient who had grade 3 sacral sore underwent flap cover with the help of plastic surgeon intervention. Other 3 patients managed conservatively

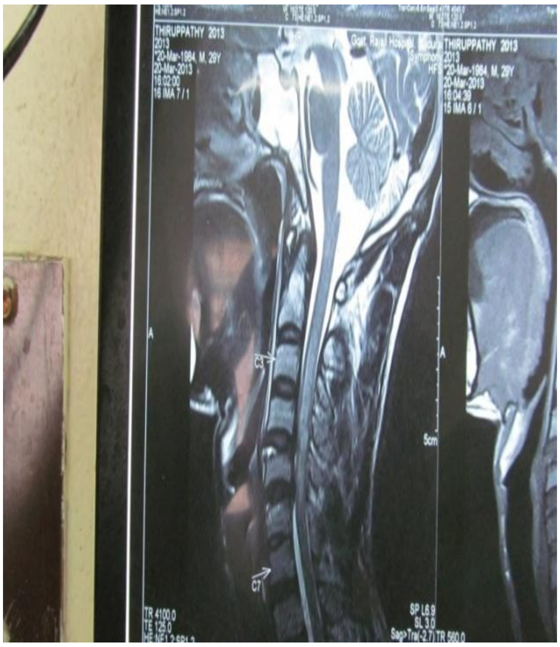
POST OPERATIVE FRANKELS GRADE.

Preoperative	Post operative					Total
	A	B	C	D	E	
A	4	3	1	0	0	8
B	_	1	-	2	2	5
C	_	_	_	4	2	6
D	_	_	_	_	1	1
E	_	_	_	_	0	0
Total	4	4	1	6	5	17

Table 11 Post operative Frankels grade.

CASE ILLUSTRATIONS

CASE 1



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FOLLOW UP


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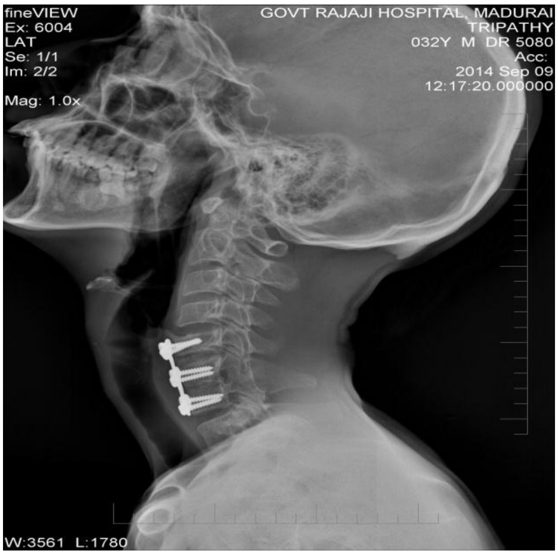
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POST OP


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FOLLOW UP


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CASE 3

POST OP


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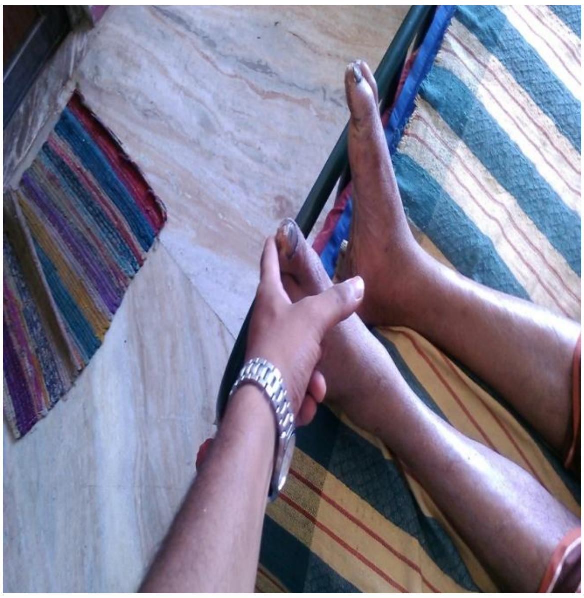

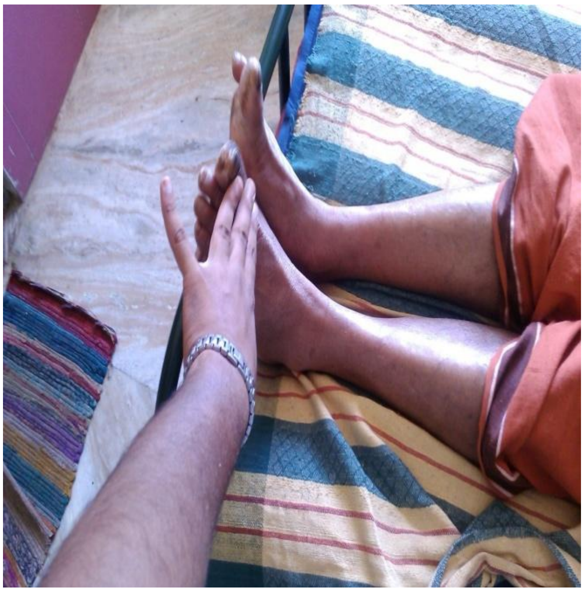

FOLLOW UP


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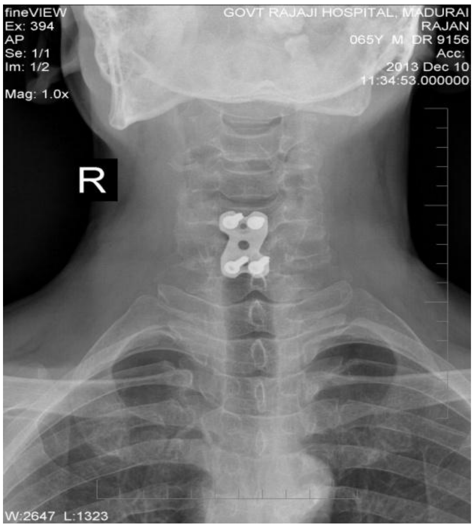
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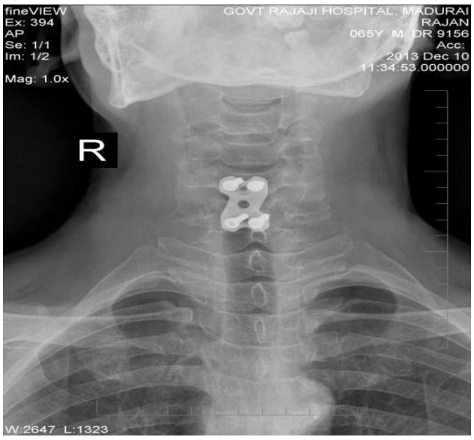
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FOLLOW UP


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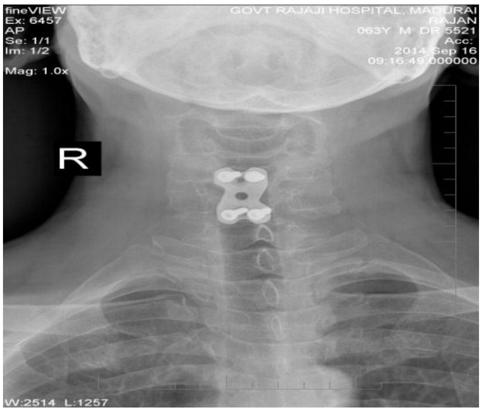
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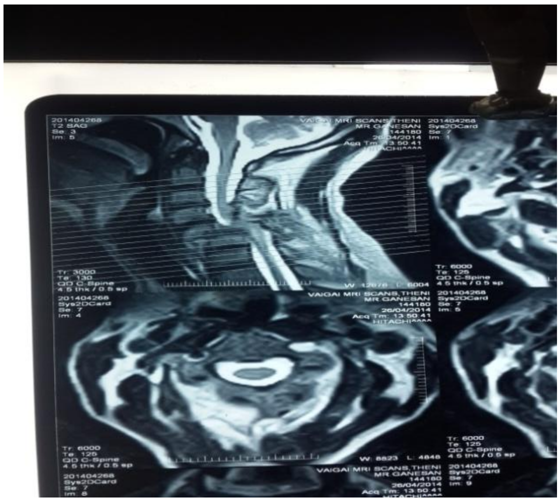
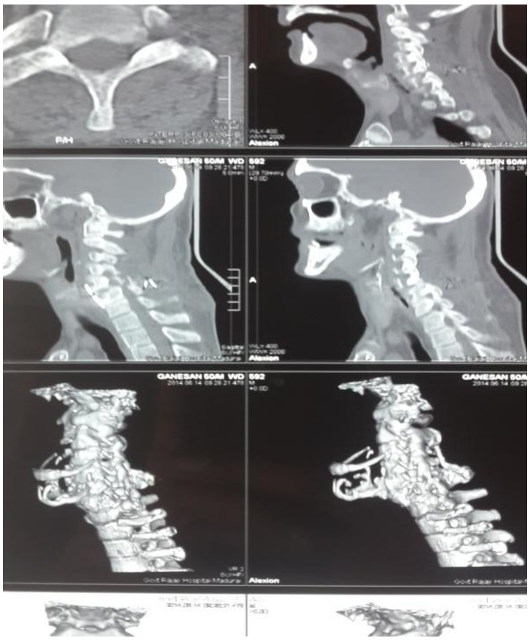
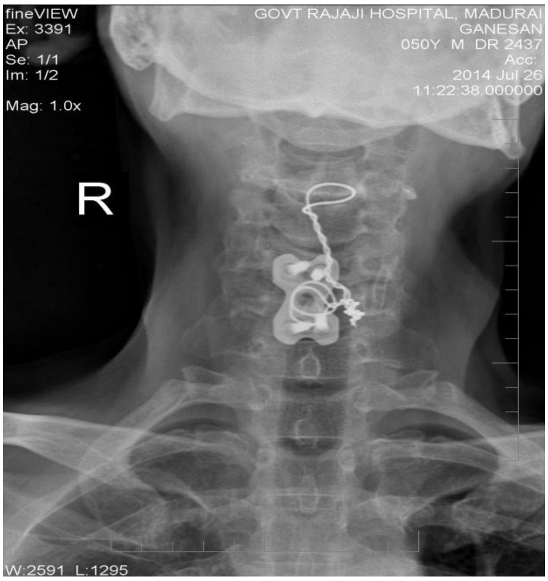
CASE 4





Post op

FOLLOW UP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GANESAN
050Y M DR 2437
Acc:
2014 Jul 26
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R
W:2591 L:1295


fineVIEW
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2014 Jul 26
11:22:38.000000
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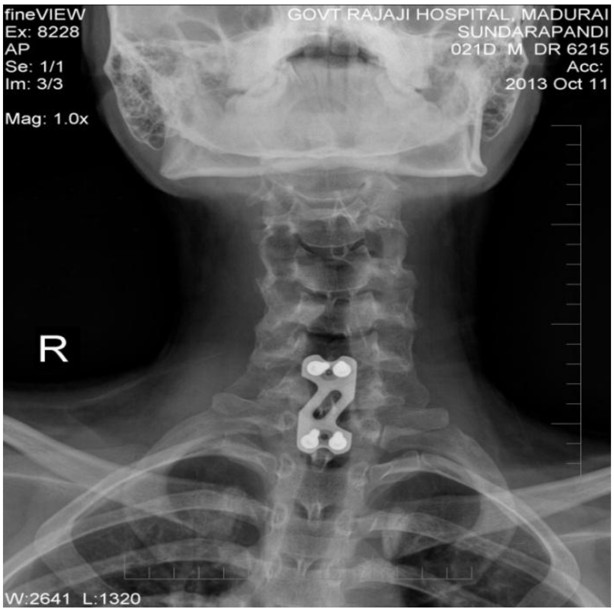
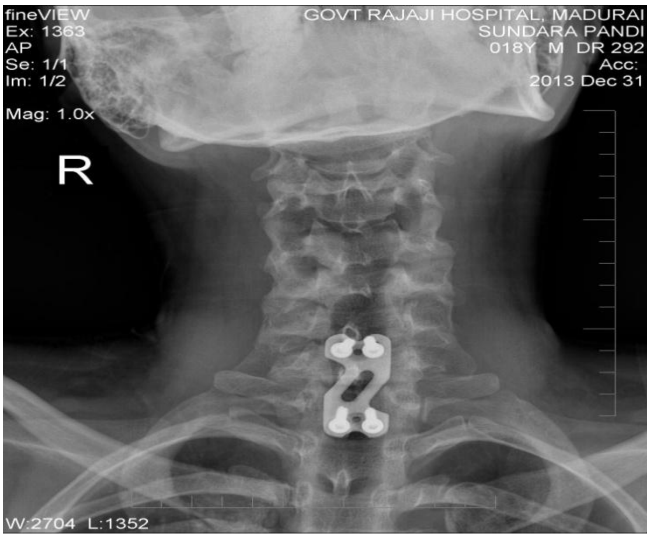
CASE 5


SUNDARAPANDI 3879
3879
*05-Aug-1992, M, 21Y
05-Aug-2013
13:26:32
11 IMA 6 / 1
HR
D1
TR 4100.0
TE 125.0
TNMSC


R
WL= 650
WW= 3500
Asteion
Coronal
Govt Rajaji Hospital,Madurai
177 RT 1460
SUNDRA PANDIYAN 21/M WD 99
A
WL= 650
WW= 3500
Asteion

POST OP AND FOLLOW UP





CASE 6


Govt. Rajaji Hospital, Madurai
Symphony
10cm
PERUMAL 3847
02-Aug-1965, M, 48Y
02-Aug-2013
12 IMA 9 / 10

POST OP


fineVIEW
Ex: 1328
LAT
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Im: 2/2
Mag: 1.0x
GOVT RAJAJI HOSPITAL, MADURAI
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2013 Dec 31
10:00:27.000000
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fineVIEW
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FOLLOW UP


fineVIEW
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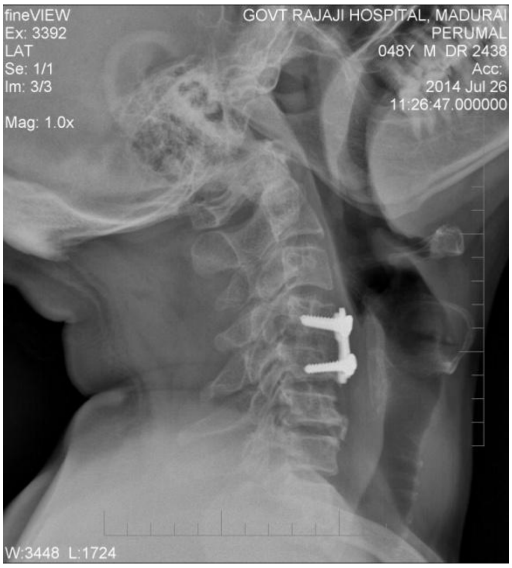
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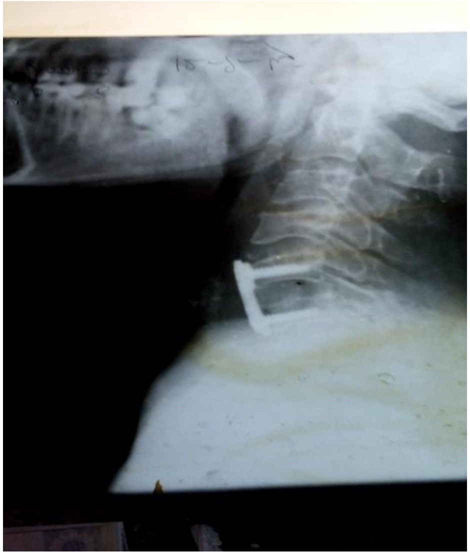
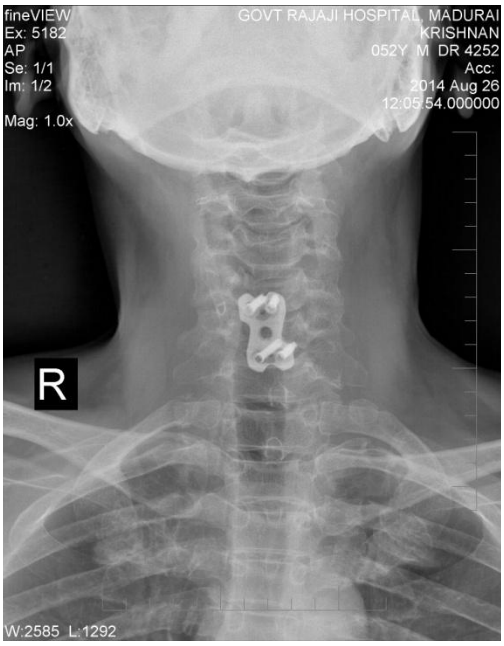
CASE 7

POST OP



FOLLOW UP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2014 Aug 26
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R
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fineVIEW
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KRISHNAN
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2014 Aug 26
12:05:54.000000
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CASE 8

POST OP

FOLLOW UP


fineVIEW
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AP
Se: 1/1
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NANTHAKUMAR
019Y M DR 2420
Acc:
2014 Jul 26
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R
W:2688 L:1344


fineVIEW
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LAT
Se: 1/1
Im: 2/2
Mag: 1.0x
GOVT RAJAJI HOSPITAL, MADURAI
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019Y M DR 2420
Acc:
2014 Jul 26
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DISCUSSION

Spine fractures and spinal cord injury were first reported more than 5,000 years ago in the Edwin surgical papyrus . This injury was described as an ailment that should not be treated because of its grave prognosis. Until the first century A.D., therefore, such injuries, primarily the result of direct blows to the spine, were usually managed only with nonoperative, supportive care. The result was usually paralysis and eventual death because there was no way to stabilize the injured spine and prevent additional damage to the neural elements.(10,11)).

However, in 600 A.D., Paul of Aegina reported the first spinal laminectomy; he found that removing spinal lamina splinters from the cord decompressed it, allowing healing (12). By the mid-twentieth century, the perceived mechanism of injury began to change from direct blows and sword-induced trauma to high-energy, indirect forces like high-energy motor vehicle and diving accidents, resulting in ligamentous and bony injuries . This change in etiology resulted in a change in treatment focus: the philosophy of laminectomy for spinal fracture and cord injury evolved to a philosophy of stabilization..(10,13)

The diagnosis of spinal injury is often delayed, and the treatment is not uniformly established. The delay in diagnosis may occur because of the lack of obvious deformity on physical or radiographic examination. The most common causes for misdiagnosis are concomitant head injury or alcohol intoxication.

Vaccaro et al formulated a subaxial cervical spine injury classification system (SLIC) in which SLIC score 5 or > 5 needs operative management. The first recorded operative treatment for spinal injury was a laminectomy in the seventh century. Today, improved operative techniques have led to major advances in spinal stabilization. The development of dedicated spinal cord injury centers and improved postoperative rehabilitation have led to significant improvement in functional outcome. The treatment of cervical spine fractures and dislocations has several goals, including reduction of the deformity and stabilization, minimizing or decreasing neurologic injury, and early rehabilitation. The choice of treatment modality is based on the anatomy of the fracture and the experience of the surgeon.(9) .

Cervical plating was widely used for stabilization of subaxial cervical spine injuries. The plate functions as a tension band in extension and as a buttress plate in flexion. After corpectomy for decompression of the spinal canal, the area is filled with a strut graft or a cage, and a plate is used as a load-sharing mechanism .(10, 14 – 17,38)

The role of timing of surgical intervention in spinal cord injury remains one of the most important topic. Despite immense research efforts related to spinal cord injury treatment , neurological recovery and overall outcome remains poor. Research using models has provided evidence that early decompression surgery can led to improved neurological recovery(10,18,19) . In our study ,progression of neurological recovery was more in patients underwent early surgical intervention . Hence early surgical intervention still offers hope (10,20,21,37).

. In selection of approaches to subaxial cervical spine injuries , the anterior approach directly addresses the injured elements and make easier to proceed with decompression , reduction,grafting and stabilization.(9,16) . In case of old neglected subaxial cervical spine injuries , combined approach is preferable , since we can directly encountered the posteriorly locked facets and to remove the excess fibrous tissues around the fracture elements. Studies also supports for global fusion for neglected bifacetal subaxial cervical spine injuries. (22,23,41).

Study conducted by Lalwani et al between 2008 to 2011 in the series of 341 cases stated 73% of patients are between 25 to 64 years of age which was comparable to 80% of patients in our study . Between 2001 to 2004 study conducted by shrestha et al showed 60% of cases are due to fall from height in a series of 149 patients with cervical spine injuries ,which was comparable to 50 % patients in our study ,since fall from height and while carrying weight is due to occupational trend in our country like agricultural and labour work .(24,25)

It was generally accepted that the most injured spinal level is at 5th and 6th cervical vertebra , as this level has greatest range of flexion or extension stress and therefore most susceptible to trauma . Zubia et al showed 31% of patients with cervical spine injuries ,the commonest level being C5-C6 , in a series of 214 patients ,conducted between 2003 to 2007 , which was similar to our study shows 35 % .(26)

In our study , most common level f injury was C5-C6 fracture dislocation (35%) followed by C6-C7 level, which was comparable to 31% noted in the earlier studies . It was generally accepted that the most injured spinal level is at 5th and 6th cervical vertebra as this level has greatest range of flexion –extension stress and is therefore most susceptible to trauma . (26,27) .

Flexion – distraction type of violence was more in the study . these injuries can result in facet sprains , facet dislocations, jumped facets or perched facets. We observed that 80% of cases are involved with flexion distractive type of violence which was more when compared to previous studies showed 61% .(28, 36).

In our study , 60% of patients were incomplete neurological deficit and 40% of patients are complete neurological deficit as per ASIA impairment scale , which was comparable to 59.5% complete neurological picture as quoted in earlier studies. Totally 3 patients was expired in which 2 patients were complete neurological deficit. Ducker et al reported 34% of mortality at the end of 1 year in their series of 273 patients with complete cord injuries ,which was more when comparable to our study 25% . (2 out of 8 patients with complete neurological deficit).(29,30, 35,39)

Pressure sore is one of the known complication in cervical spine injuries. In our study, 4 patients had sacral pressure sore ,tnree patients treated conservatively.One patient underwent flap cover with the help of plastic surgery intervention. Stal et al cited a 20% incidence in paraplegic patients and a 26% incidence in patients who are quadriplegic ,which was comparable to 20% in our series.(31,32).

Paramore et al reported hardware failure in 22% patients and concluded that plate length correlates with instrumentation problems. While in our study , there was no complications related to plating like screw pullout and implant failure. The normal lordotic curve of cervical spine is maintained in all cases.(33,34).

Patients were classified into five grades as per ASIA impairment scale. In grade A out of 8 patients , 4 patients had no improvement , 3 patients gained some sensory improvement of which one patient died after two months due aspiration pneumonitis and 1 patient improved to grade C. In grade B ,out of 5 patients ,2 patients improved to grade D, 2 patients improved to grade E and one patient died on immediate post operative period. In grade C , out of 6 patients 4 patients improved to grade D and 2 patients improved to grade E . One patient in grade D improved to grade E after surgical intervention . We had no patients on grade E. In our study , patients improved to grade 2 more power after early surgical stabilization and no patient underwent neurological deterioration.

CONCLUSION

The ultimate goal of surgical intervention for subaxial cervical spine injuries is stabilization of spine , restoration of spinal anatomy,decompression of neural elements, there by promoting the neurological recovery and early facilitation of rehabilitation . In our study , we achieved a good functional outcome following surgical intervention. To conclude that early surgical stabilization of subaxial cervical spine injuries had good functional outcome , provided detailed clinical and radiological assessment ,proper preoperative planning , selection of surgical approaches , precision in surgical techniques and early rehabilitation program are needed in achieving good results and minimising complications.

BIBLIOGRAPHY

1. Rockwood & Greens fractures in adults. Sixth edition. Pages 1947-1539 (9,34,40)

2. Acute Spinal Cord Injury, Part I: Pathophysiologic Mechanisms, Department of Neurological Surgery, University of Virginia, Charlottesville, Virginia, USA; and ‡Division of Neurosurgery and University of Calgary Spine Program, University of Calgary, Calgary, Alberta, Canada , *Clinical Neuropharmacology* Vol. 24, No. 5, pp. 254–264 , © 2001 Lippincott Williams & Wilkins, Inc., Philadelphia(10,11)

3. Grubb MR, Currier BL, Stone J, Warden KE, An KN.Biomechanical evaluation of posterior cervical stabilization after a wide laminectomy. *Spine* 1997;22:1948-54.(14,15)

4. .Grays anatomy 39TH edition(16-22 , 32,34)

5. Stanley Hoppenfeld, Piet de Boer-Surgical approaches in Orthopaedics, The anatomic approach fourth edition.(23-27)

6. Campbell's Operative Orthopaedics, 11th edition and 12th edition.(28-31,33,35,36,38,40,48)

7. Southwick WO, Robinson RA Surgical approaches to the vertebral bodies in the cervical and lumbar regions,J Bone and Joint Surgery 631A,39,1957.(40,51-54)

8. .Bailey RW and Badgley CE et al. Stabilisation of cervical spine by anterior fusion J Bone and Joint Surgery,42 A 565-594,1960 (40)

9. The Surgical Approach to Subaxial Cervical Spine Injuries . An Evidence-Based

Algorithm Based on the SLIC Classification System

Marcel F. Dvorak, MD, FRCSC, Charles G. Fisher, MD, MHSc, FRCSC, SPINE Volume 32, Number 23, pp 2620–2629 . (37,40,41-46,102,103)

10.Frymoyer adult and paediatric spine surgery 2nd edition chapter 34 .(54,101,102) .

11.Garfin SR,Blair B,Eismont FJ,et al.Skeletal trauma ; fractures ,dislocations,ligamentous injuries 2nd edition Philadelphia :W B Saunders ,1998 :947-1034 (101)

12. Shannon E,MacMilan M. Fractures and dislocations of cervical spine injures , Rockwood & Greens fractures in adults, 4th edition 1996 : 947-1034.(101)

13. Fife D, Kraus J.Anatomic location of spinal cord injury. Relationship to cause of injury . Spine 1986 ; 11(1) :2-5.(101)

14. . de Oliveira JC. Anterior plate fixation of traumatic lesions of the lower cervical spine. *Spine* 1987;**12**:324-29. (102)

15. . Aebi M, Zuber K, Marchesi D. Treatment of cervical spine injuries with anterior plating. Indications, techniques, and results. *Spine* 1991;**16**:38-45.(102)

16. . Grubb MR, Currier BL, Shih JS, Bonin V, Grabowski JJ, Chao EY. Biomechanical evaluation of anterior cervical spine stabilization. *Spine* 1998;**23**:886-92.(102,103)

17. Thalgott JS, Xiongsheng C, Giuffre JM. Single stage anterior cervical reconstruction with titanium mesh cages, local bone graft, and anterior plating. Spine J 2003;3:294–300.(102)

18. Bohlman HH Acute fractures and dislocations of the cervical spine. An analysis of three hundred hospitalized patients and review of the literature.

J Bone Joint Surg Am. 1979 Dec;61(8):1119-42.(102)

19 . *Paul J. Schenarts, MD, Jose Diaz, MD, Clay Kaiser,* Prospective Comparison of Admission Computed Tomographic Scan and Plain Films of the Upper Cervical Spine in Trauma Patients with Altered Mental Status , *J Trauma.* 2001;51:663–669. (102)

20. Neurologic Outcome of Early *Versus* Late Surgery for Cervical Spinal Cord Injury Vaccaro, Alexander R. MD*; Daugherty, Reza J. BA§; Sheehan, Terrence P. MD‡; Dante, Stephen J. MD†; **Spine** Issue: Volume 22(22), 15 November 1997, pp 2609-2613.(102)

21. Subaxial (C3-C7) cervical spine injuries : Comparison of early and late surgical Intervention Vashdev Chandwani MS, BK Ojha M Ch, Anil Chandra M Ch, Mohammad Kaif MS, Vishwanath GU MS , Department of Neurosurgery, CSMMU (Upgraded King George's Medical University), Lucknow . Indian Journal of Neurotrauma *(IJNT) 2010, Vol. 7, No. 2, pp. 145-148(102)*

22. Circumferential fusion for sub-axial cervical spine fracture – subluxations T S Vasan M Ch Department of Neurosurgery Command Hospital (EC), Kolkata (WB) Indian Journal of Neurotrauma (*IJNT) 2007, Vol. 4, No. 1, pp. 65-70 (103)*

23 . Management of neglected cervical spine dislocation: a study of six cases Vijay Goni, Nirmal Raj Gopinathan, Vibhu Krishnan, Rajesh Kumar*, Avinash Kumar, Chinese Journal of Traumatology . 212 . 2013;16(4):212-215.(103)

24. Mortality profile of patients with traumatic spinal injuries at a level I trauma care centre in India S. Lalwani, V. Singh*, V. Trikha*, V. Sharma*, S. Kumar, R. Bagla, D. Aggarwal** & M.C. Misra†, Departments of Forensic Medicine And Toxicology, *Orthopaedics, **Neurosurgery & †Surgical Disciplines, Jai Prakash Narayan Apex Trauma Center, All India Institute of Medical Sciences, New Delhi, India

Indian J Med Res 140, July 2014, pp 40-45.(103)

25. Cervical spine injuries in Nepal , A clinic- epidemiological study Shrestha D, Carg M,.Department of Orthopaedics, B P Koirala institute of health sciences ,dharan, Nepal . J Nepal Med Assoc 2007; 46 (167): 107-111(103)

26. Traumatic Cervical Spine Injury Pattern– A Snapshot

Joshi M.1, Agrawal Mahima2, IJPMR September 2012; Vol **23 (3):** 111-6.(103)

27 . Solagberu BA. Spinal cord injuries in Ilorin, Nigeria.

West Afr J Med 2002; **21:** 230-2.(103)

28 . Flexion-Distraction Injuries of the Subaxial Cervical Spine ,

Kris Radcliff, MD,a,b,* and Benjamin G. Thomasson, DOc

a Department of Orthopedic Surgery, Rothman Institute, Thomas Jefferson University, Philadelphia, PA , SEMINARS IN SPINE SURGERY 25 (2013) page 45–56 (103,104)

29. Factors affecting long-term outcome in acute cervical cord injury

KVL Narasinga Rao M Ch, M Vijaya Saradhi M Ch, AK Purohit M Ch

Department of Neurosurgery, Nizam's Institute of Medical Sciences, Hyderabad.

Indian Journal of Neurotrauma (IJNT) 2010, Vol. 7, No. 2, pp. 149-156. (103)

30. Burns SP, Golding DG, Rolle WA Jr, Graziani V, Ditunno JF

Jr. Recovery of ambulation in motor-incomplete tetraplegia.

Arch Phys Med Rehabil 1997; 78:1169-72. (103)

31. Stal S, Serure A, Donovan W, et al. The perioperative management of the

patient with pressure sores. *Ann Plast Surg*. 1983;11:347 (104)

32. PRESSURE SORES , chapter 74,

JOHN D. BAUER, JOHN S. MANCOLL, AND LINDA G. PHILLIPS(104)

33. ANTERIOR DECOMPRESSION, FUSION AND PLATING IN CERVICAL

SPINE INJURY: OUR EARLY EXPERIENCE

Riaz A. Raja, Asadullah Makhdoom, Aftab Ahmed Qureshi

Department of Neurosurgery, Liaquat, University of Medical and Health Sciences,

Jamshoro, Pakistan . J Ayub Med Coll Abbottabad 2008;20(4) (104)

34 . Paramore CG, Dickman CA, Sonntag CKH. Mechanisms of

caspar plate failure. J Neurosurg 1995;82:3611.(104)

35 . Neurological recovery after surgical intervention in lower cervical spine

injures,Moslem shakeri medwell surgery journel 58-60,2008.(104)

36. Treatment of Subaxial Cervical Spinal Injuries

journal of neurosurgery , Neurosurgery 72:187–194, 2013, (104)

37. The Functional And Neurological Outcome In Cervical Spine Injuries:

A Retrospective Review.

The Internet Journal of Orthopedic Surgery . 2009 Volume 17 Number 1.(102)

38. Anterior decompression, fusion and plating in cervical spine injury: Early experience

in Abuja, Nigeria

Surgical Neurology International , Published: 14 November 11 (102)

39 . Evaluation of morbidity, mortality and outcome following cervical spine injuries in elderly patients Eur Spine J (2008) 17:585–591.(104)

40. Long-term Follow-up of Whiplash Injury of the Neck
Journal of Orthopaedics, Trauma and Rehabilitation 17 (2013) 77 edition 81.(103)

41. Delayed presentation of cervical facet dislocations Saumyajit Basu, Farid H Malik , Jay Deep Ghosh, Agnivesh Tikoo Department of Neurosciences, Park Clinic, Minto Park, Kolkata, India, *Journal of Orthopaedic Surgery 2011;19(3):331-5. (103).*

CONSENT FORM FOR OPERATION/ANAESTHESIA

I ____________________ Hosp. No.____________ in my full senses

Here by give my complete consent for ________________ or any other procedure deemed fit which is a diagnostic procedure / biopsy / transfusion / operation to be performed on me / my son / my daughter / my ward __________ age __________ under any anaesthesia deemed fit.

The nature and risks involved in the procedure have been explained to me to my satisfaction. For academic and scientific purpose the operation/procedure may be televised or photographed.

Date :

Signature/Thumb Impression

of Patient/Guardian

Name :

Designation:

Guardian

Relationship

Full address

PROFORMA

NAME:

AGE&SEX:

IP NO: UNIT: WARD:

ADDRESS:

PH NO:

DOA:

DOS:

DOD:

MODE OF INJURY:

GENERAL EXAMINATION:

NEUROLOGICAL EXAMINATION:

NEUROLOGICAL GRADE(FRANKELS):

X-RAY CERVICAL SPINE:

CT CERVICAL SPINE:

MRI CERVICAL SPINE:

SLIC SCORE :

TREATMENT:

ANAESTHESIA:

POSITION:

APPROACH:

INTRA OP FINDINGS:

IMPLANT USED:

INTRA OP COMPLICATIONS:

BLOOD LOSS:

NO OF UNITS BLOOD TRANSFUSED:

DURATION:

POST OP NEUROLOGY(Frankels grade):

POST OP X-RAY:

CONDITION ON DISCHARGE:

FOLLOW UP

1.

2.

3.

S NO.	NAME	AGE	S NO	IP NO.	MODE OF INJURY	DIAGNOSIS	CLASSIFICATION –ALLEN FERGUESON	SLIC SCORE	APPROACH	PROCEDURE	COMPLICATION
1	THIRUPATHY	32	M	18820	FALL FROM HEIGHT	C4-C5,C5-C6 TRAUMATIC DISC PROLAPSE		5	SOUTHWICK ROBINSON APPROACH	C4-C5,C5-C6 DECOMPRESSION ,FUSION AND STABILISATION	NIL
2	MURUGAN	38	M	46585	FALL OF HEAVY WEIGHT OVER HEAD	C5-C6 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE III	8	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
3	UTTRIYAN	48	M	47899	SLIP AND FALL ON GROUND LEVEL	C6-C7 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE III	7	ANTERIOR	C6-C7 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	DIED AFTER 2 MONTHS
4	RAJAN	62	M	48890	FALL OF HEAVY WEIGHT OVER HEAD	C5-C6 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE III	8	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
5	PERUMAL	48	M	47986	ROAD TRAFFIC ACCIDENT	C4-C5 FRACTURE DISLOCATION	FLEXION DISTRACTION STAGE II	8	ANTERIOR	C4-C5 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
6	MURUGESAN	53	M	10987	ROAD TRAFFIC ACCIDENT	C6-C7 FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE III	8	COMBINED	C6-C7 ACDF AND POSTERIOR ROGERS INTERSPINOUS WIRING	NIL
7	PANDIYAN	45	M	48765	FALL FROM HEIGHT	C6-C7 FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE II	7	ANTERIOR	C6-C7 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	GRADE III SACRAL BED SORE
8	SOUNDARAPANDIYAN	21	M	5324	FALL FROM HEIGHT	C7 BURST FRACTURE	VERTICAL COMPRESSION VIOLENCE STAGE III	6	ANTERIOR	C7 CORPECTOMY AND STABILISATION AND FUSION	GRADE II SACRAL BED SCORE
9	CHELLAKANNU	40	M	54747	FALL FROM HEIGHT	C5C6 FRACTURE DISLOCATION / LOCKED FACETS	DISTRACTIVE FLEXION STAGE III	7	ANTERIOR	C6 CORPECTOMY ANTERIOR STABILISATION AND FUSION	PATIENT EXPIRED ON 3RD POST OP DUE TO ARDS
10	MOORTHY	50	M	12123	FALL FROM HEIGHT	C6-C7 FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE II	7	ANTERIOR	C6-C7 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
11	MARIYAPPAN	55	M	6985	ROAD TRAFFIC ACCIDENT	C5C6 SUBLUXATION WITH DISC PROLAPSE	COMPRESSIVE FLEXION STAGE II	8	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
12	MUTHUMANI	42	M	89786	ROAD TRAFFIC ACCIDENT	C5-C6 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE II	7	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	PATIENT DIED AFTER 2 WEEKS
13	PARTHIBAN	45	M	34342	ROAD TRAFFIC ACCIDENT	C6-C7 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE II	8	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
14	GANESAN	50	M	3626	FALL FROM HEIGHT	C5C6 BIFACETAL DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE III	8	COMBINED	C6-C7 ACDF AND POSTERIOR ROGERS INTERSPINOUS WIRING	NIL
15	GOPAL	50	M	6207	ROAD TRAFFIC ACCIDENT	C4-C5 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE II	7	ANTERIOR	C4-C5 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
16	CHANDRAKUMAR	33	M	8104		C5-C6 FRACTURE DISLOCATION	FLEXION DISTRACTION VIOLENCE STAGE II	6	ANTERIOR	C5-C6 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL
17	KRISHNAN	52	M	6083	FALL	C5-C6		8	ANTERIOR	C5-C6 ANTERIOR	NIL

					FROM HEIGHT	FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE II			CERVICAL DECOMPRESSION AND FUSION	
18	NANDAKUMAR	19	M		ROAD TRAFFIC ACCIDENT	C7 BURST FRACTURE	VERTICAL COMPRESSION STAGE III	6	ANTERIOR	C7 CORPECTOMY , FUSION AND STABILISATION	GRADE II SACRAL BED SCORE
19	GURUSAMY	28	M	65386	ROAD TRAFFIC ACCIDENT	C6C7 FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE II	7	ANTERIOR	C6-C7 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	GRADI II SACRAL SORE
20	MANOHARAN	59	M	9721	FALL FROM HEIGHT	C4-C5 FRACTURE DISLOCATION	DISTRACTIVE FLEXION STAGE II	6	ANTERIOR	C4-C5 ANTERIOR CERVICAL DECOMPRESSION AND FUSION	NIL

Patient Name ______________________________

Examiner Name ______________________________ Date/Time of Exam ______________

ASIA — AMERICAN SPINAL INJURY ASSOCIATION

STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ISCoS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5			Elbow flexors
C6			Wrist extensors
C7			Elbow extensors
C8			Finger flexors (distal phalanx of middle finger)
T1			Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

Comments:

	R	L	
L2			Hip flexors
L3			Knee extensors
L4			Ankle dorsiflexors
L5			Long toe extensors
S1			Ankle plantar flexors

Voluntary anal contraction (Yes/No) ☐

LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

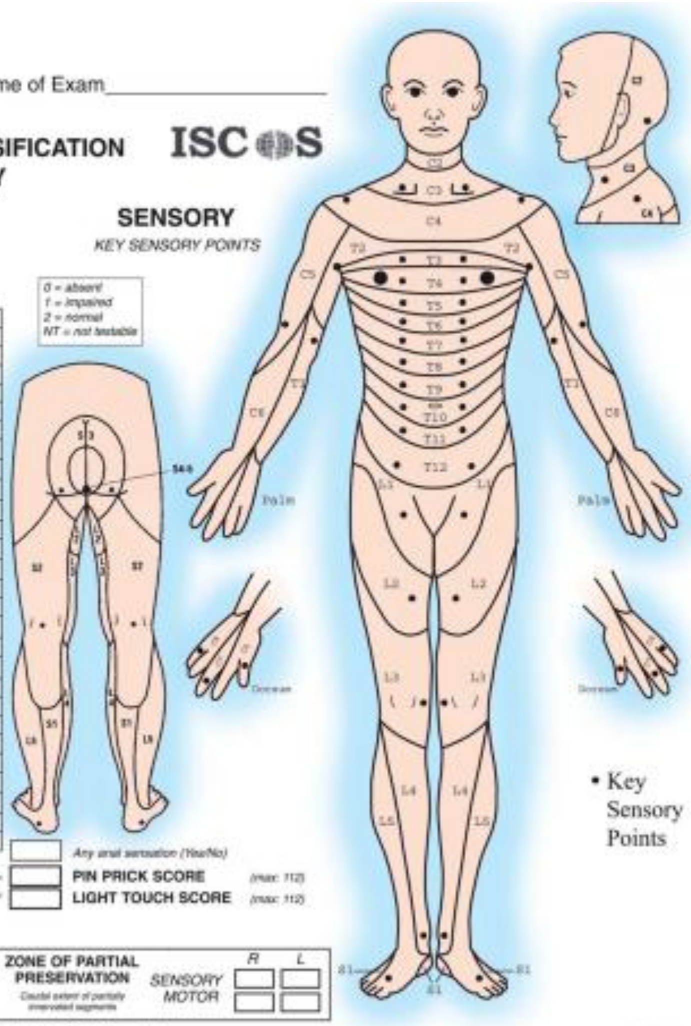
0 = absent
1 = impaired
2 = normal
NT = not testable

Any anal sensation (Yes/No) ☐

TOTALS ☐ + ☐ (MAXIMUM) (56) (56) ☐ + ☐ (56) (56)

PIN PRICK SCORE (max: 112)

LIGHT TOUCH SCORE (max: 112)



NEUROLOGICAL LEVEL (The most caudal segment with normal function)	R	L
SENSORY		
MOTOR		

COMPLETE OR INCOMPLETE? ☐ (Incomplete = Any sensory or motor function in S4-S5)

ASIA IMPAIRMENT SCALE ☐

ZONE OF PARTIAL PRESERVATION (Caudal extent of partially innervated segments)	R	L
SENSORY		
MOTOR		

A

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A STUDY ON FUNCTIONAL OUTCOME FOLLOWING SURGICAL FIXATION FOR SUBAXIAL CERVICAL SPINE INJURIES

DISSERTATION SUBMITTED FOR

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BRANCH – II (ORTHOPAEDIC SURGERY)

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Text-Only Report

Ref.No.6506/E1/5/2014

Madurai Medical College,
Maduai -20. Dated: 19. 09.2014.

Institutional Review Board/Independent Ethics Committee
Capt.Dr.B.Santhakumar,MD (FM). deanmdu@gmail.com
Dean, Madurai Medical College &
Government Rajaji Hospital, Madurai 625 020 . Convenor

Sub: Establishment – Madurai Medical College, Madurai-20 –
Ethics Committee Meeting – Meeting Minutes - for August 2014 –
Approved list – reg.

The Ethics Committee meeting of the Madurai Medical College, Madurai was held on 05th August 2014 at 10.00 Am to 12.00 Noon at Anaesthesia Seminar Hall at Govt. Rajaji Hospital, Madurai . The following members of the Ethics Committee have attended the meeting.

1.Dr.V.Nagarajan,M.D.,D.M(Neuro) Ph: 0452-2629629 Cell No.9843052029 nag9999@gmail.com.	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	Chairman
2.Dr.Mohan Prasad, MS.M.Ch. Cell.No.9843050822 (Oncology) drbkcmp@gmail.com	Professor & H.O.D of Surgical Oncology (Retired) D.No.32, West Avani Moola Street, Madurai.-1	Member Secretary
3. Dr.L.Santhanalakshmi, MD (Physiology) Cell No.9842593412 dr.l.santhanalakshmi@gmail.com.	Vice Principal, Prof. & H.O.D. Institute of Physiology Madurai Medical College	Member
4.Dr.K.Parameswari, MD(Pharmacology) Cell No.9994026056 drparameswari@yahoo.com.	Director of Pharmacology Madurai Medical College.	Member
5.Dr.S.Vadivel Murugan, MD., (Gen.Medicine) Cell No.9566543048 svadivelmurugan_2007@rediffmail.com.	Professor & H.O.D of Medicine Madurai Medical College	Member
6.Dr.A.Sankaramahalingam, MS., (Gen. Surgery) Cell.No.9443367312 chandrahospitalmdu@gmail.com	Professor & H.O.D. Surgery Madurai Medical College.	Member
7.Mrs.Mercy Immaculate Rubalatha, M.A., Med., Cell.No.9367792650 lathadevadoss86@gmail.com	50/5, Corporation Officer's Quarters, Gandhi Museum Road, Thamukam, Madurai-20.	Member
8.Thiru.Pala.Ramasamy, B.A.,B.L., Cell.No.9842165127 palaramasamy2011@gmail.com	Advocate, D.No.72,Palam Station Road, Sellur, Madurai-20.	Member
9.Thiru.P.K.M.Chelliah, B.A., Cell No.9894349599 pkmandco@gmail.com	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20.	Member

The following Project was approved by the Ethical Committee

Name of P.G.	Course	Name of the Project	Remarks
Dr.M.Ganeshkumar **drganeshkumar33@gmail.com**	PG in MS (Orthopaedic) Madurai Medical College, and Govt. Rajaji Hospital, Madurai	**"A study on functional outcome following surgical fixation for subaxial cervical spine injuries".**	**Approved.**

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain it Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution or to Government.
2. She/He should inform the institution Ethical Committee, in case of any change of study procedure, site and investigation or guide.
3. She/He should not deviate the area of the work for which applied for Ethical clearance. She/He should inform the IEC immediately, in case of any adverse events or Serious adverse reactions.
4. She/He should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and if any Extension of time is required He/She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the work or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Member Secretary
Ethical Committee

Chairman
Ethical Committee

11.9.14
DEAN/Convenor
Madurai Medical College & Govt. Rajaji Hospital, Madurai- 20.

11/9/14

To
The above Applicant
-thro. Head of the Department concerned